ENGINEERING NEWS

ANOTHER grillage for the Poughkeepsie bridge was successfully launched March 25, and the large caisson for Pier No. 4 towed to its place on the bridge line. The anchorages for it were also towed out into the river. Twenty car-loads of steel and iron have arrived for use on the superstructure. The work of erecting the false-work is well advanced, and the material for the shore arms of the cantilevers is on the ground. The work is progressing very rapidly.

A BILL has been introduced in Rhode Island to have all the bridges in the State examined by "a competent engineer" at the expense of the State, and appropriating $1,000 for the purpose. We do not know how many bridges there may be in the State, but as there are 3,500 in New York, over 1,000 in Massachusetts, and probably at least 100 in Rhode Island, we do not imagine that any very thorough examination can be had for the money. They will probably get $1,000 worth of inspection, but we might apply the answer of a certain chief engineer to his economical board of directors. "Gentlemen, I have given you fully $5,000 worth of location, though the country is such as to have required the expenditure of $40,000; you saw fit to fix limits to this very necessary work, and I have fairly expended your money—but no more."

THE Texas Senate has passed the bill to enforce the section of the State Constitution prohibiting the consolidation of parallel competing railroad lines. It fixes the penalty for the offense at from $1,000 to $4,000, and makes it felony punishable with imprisonment in the penitentiary for railroad owners or agents to violate the act.——The Michigan Senate has passed a bill prohibiting the use of stoves or heaters in railroad cars after November 1, 1888, unless enclosed in compartments built of boiler iron. Also a bill prohibiting the use in the State after January 1, 1889, of any freight car not provided with an automatic coupler.——The New York Senate has passed a bill which provides that where a railroad overcomes more than 1,000 ft. of elevation within two miles, the company may charge 7 cts. for each 100 ft. of elevation. Where it overcomes an elevation exceeding 300 ft. to the mile and is now operating by locomotives, a charge of 5 cts. for each 100 ft. may be made; where it overcomes an elevation of over 200 ft. to the mile for at least two consecutive miles, and does not exceed twenty miles in length and is operated by locomotives, the company may charge 10 cts. per mile. The bill is intended to apply to the Catskill mountain railroads.

THE Swannanoa tunnel on the Western North Carolina Railway, twenty miles from Asheville caved in on April 5. Cause: Rotten wooden timbering, which was being renewed too late. The tunnel is in the Blue Ridge Mountains, 1,800 ft. long, at an elevation of 4,000 ft. above the sea. It is partly in solid rock and partly in earth. There has always been some trouble in regard to it, and a large portion of its roof is supported by "powerful beams." The tunnel was excavated by convicts, and these have since done much work in keeping it fit for traffic. There were over fifty men at work in the tunnel when it caved in, and only two escaped uninjured, thirteen being supposed to be fatally injured, although no one was killed.

AT Washington, D. C., it is reported that among the changes which the increase of the work of the engineering department of the District is likely soon to develop is separation of the surface from subsurface work, so that all matters of sewers, excavations, etc., will be in charge of one officer, while buildings, pavements, grades, etc., will be in charge of another. The public work underground in Washington is now estimated to be nearly one-fourth of that done above the surface, and it is thought to require such diligent and constant supervision and inspection as to need the services of a special officer.

A MOVEMENT is going on in Baltimore and New York to establish at Curtis bay an extensive steel pipe works. It is also proposed to make steel guns of heavy calibre without boring. Mr. ROBERT GARRETT is stated to be interested in the enterprise, and to have offered to take $25,000 of the stock.

The Engineer has been examining into the financial status of the proposed American Exhibition in London, and from the data furnished by the company itself finds about as follows: To Jan. 14, 1887, the whole of the paid-up capital was £37,703 6s. 8d. (about $188,716). Out of this amount $29,375 will have to be paid to Mr. JOHN ROBINSON WHITLEY and Gen. CHAS. B. NORTON, "as the agreed amount of remuneration, office rent, salaries, wages, disbursements, etc., in connection with the scheme anterior to the incorporation of the company;" and in addition a salary of $7500 to Mr. Whitley and $5000 to Gen. NORTON. Even with the $125,000 new capital recently called for, the Exhibition would seem to have at its command a very small part of the sum required for the building and fitting up of so ambitious an international affair as its promoters promise.

THE fight between the Chicago authorities and the inhabitants of Joliet and the valley of the Illinois river generally over the proposed diversion of the Chicago sewage flow down that river, is assuming a very bitter shape. But from a general summary of the statements for and against the scheme, it would seem, that with the proposed deepening of channel and increase in volume, and consequent dilution of offensive matter and elimination of shallow flowage, the district passed through would be much benefitted rather than harmed. Late investigations by the State Board of Health show that an increase in volume of flow by the pumpage of 50,000 cu. ft. per minute at the Chicago end almost at once decreased the proportion of organic matter to a marked degree. The Board found that the amount of sewage pollution was almost entirely dependent upon the amount of water passing through the canal from the Chicago river; and that there was not as much when navigation was closed as when this matter was stirred up by passing vessels.

IT is alleged that Mr. JAY GOULD will emulate Mr. PULLMAN by establishing an "industrial village of light, airy houses, shops and accessories" near St. Louis. The report is of doubtful authenticity, especially as to the details.

THE evil day which seems near at hand when it will be absolutely impossible to carry the flood of travel over the East River bridge by existing methods and facilities has been again postponed by adopting four-car instead of three-car trains. Thirteen in all are kept moving on 90 second headway: the speed being 10 miles per hour and the round trip made in 15 minutes, allowing 1½ minutes for loading and unloading. By the time a train is empty another train is within 600 ft. of the platform, by this arrangement.

THE already long death roll of the new Croton aqueduct tunnel has been again increased by the falling of an unsecured cage, on which a man stepped at the top of the shaft (No. 10) It fell under his weight upon three men beneath, killing them instantly.

This is said to be due to the neglect of a laborer to secure the cage. No doubt it was; but there are inexpensive ways of guarding against such contingencies mechanically, and contractors should not be permitted to neglect them so lightly. Nothing may be more certainly determined from experience and from reason than that, when death and life depend only on human memory and caution, death will frequently result. To depend upon it unnecessarily, therefore, is a criminal act morally, and it should be so in law.

THE Baltimore & Ohio terminal improvements at Staten Island seem now to be assured, proposals being now asked for the Arthur Kill bridge, connecting with the main land. The contract is to be awarded April 23.

A NEW system of automatic block signals, operated by the passage of the train and turning a red signal immediately behind it, is to be introduced on all the elevated lines in New York. It is the invention of Mr. ROBERT BLACK, the general roadmaster, and has been undergoing successful test on the Ninth Avenue line, between Christopher and Fourteenth streets for some weeks. Mr. BLACK says, we fear over confidently:

"In all former automatic signals, the great difficulty has been to overcome the impact of the blow from a running engine or train, and it has been effectually mastered in this signal, as the motion of the target is entirely devoid of jar. This system of signals, I predict, will soon be in operation on all the railroads of the United States, and with them the chances of accidents by trains running into the rear of others will certainly be greatly lessened."

"The Association of Railroad Superintendents of North America"—a small organization with a very large name, held their annual meeting on the 12th inst. in this city. The most interesting feature was a cordial endorsement by Prest. WM. S. STEVENSON, of the PHELPS system of telegraphing by induction between moving trains. The system has been under test on the New York & New Haven R. R. for two or three years, under Mr. STEVENSON'S eye, and he stated that it was to be extended to Springfield shortly.

THE spring freshets, due to the thaw, have caused serious floods and damage to properties. The Mohawk, Hudson, Salmon, Chenango and Susquehanna rivers in New York, the White and Winooski rivers in Vermont, the Contoocook, Warner, Nashua and Merrimac rivers in New Hampshire, and the Delaware river in Pennsylvania have overflowed. Washouts have occurred on the New York Central, the Delaware & Hudson and the Central Vermont railroads. Five highway bridges, and several small bridges, have been wrecked, three dams carried away, two culverts and two trestles washed out. Another result of the thaw is the landslide on the Central Vermont line at Cuttingsville, the roadbed for a distance of 100 ft. and to a depth of 50 ft., sliding down 150 ft. into the highway, and this after successfully sustaining, we believe, the effects of some 35 or 40 winters since the construction of the road.

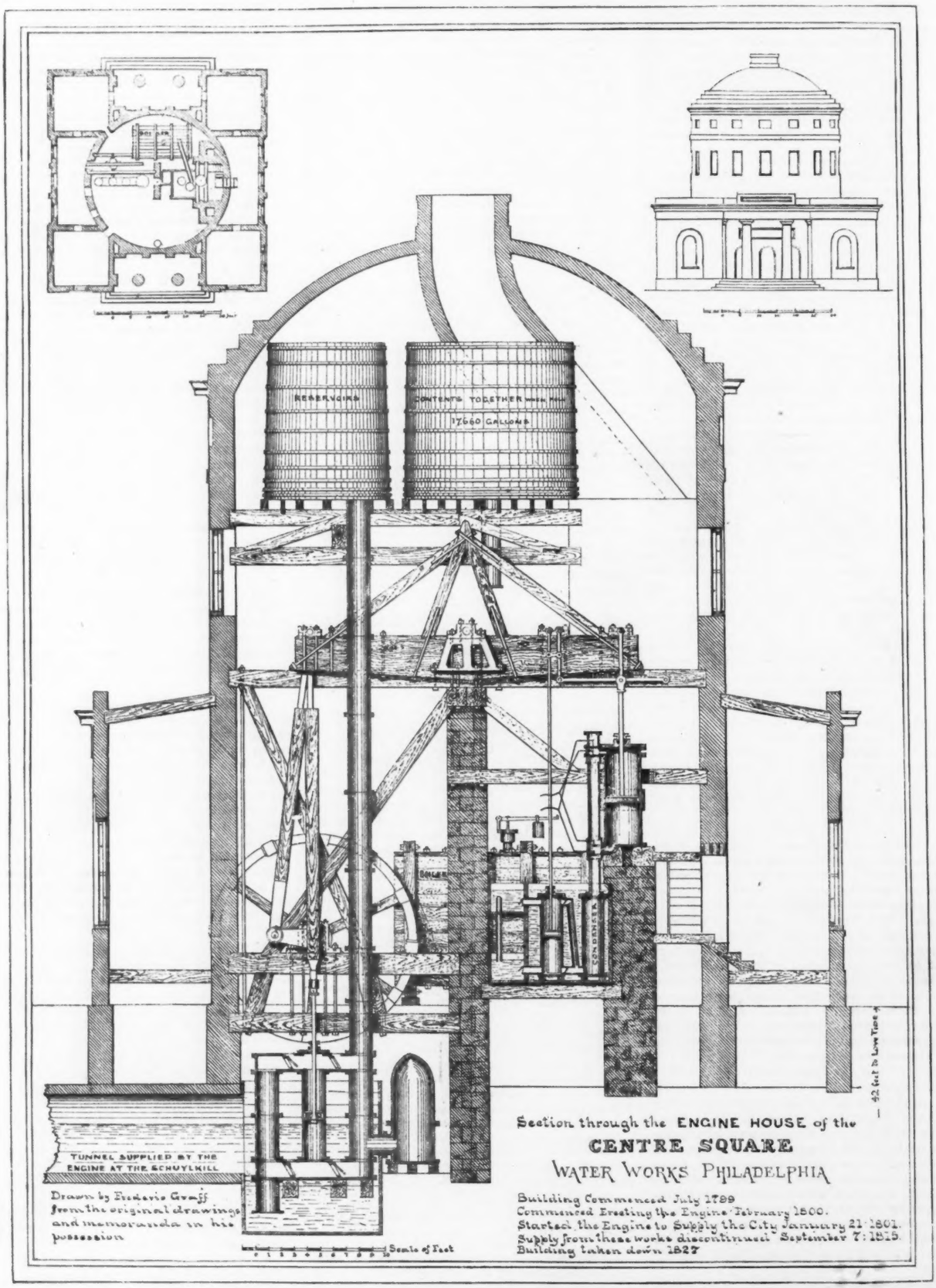
THE most serious railroad accident of the week occurred April 13, and was due to an alleged obstruction on the Ohio River Railroad near Parkersburg, W. Va. A construction train jumped the track and the engine and nine cars were wrecked. Three men were killed and eight or ten injured, some of them fatally.

THE fall of the Bussey bridge occurred on Monday, March 14; the investigation closed, after taking evidence for twelve days, on Monday, April 4. As we write on Friday, April 15, eleven days later, no findings have been announced, or if they have been announced, they have not been republished in the newspapers. The great public has all but forgotten that there ever was such an event to investigate, and the part of the report which will do most to form public opinion, we may reasonably fear, has already been made—by actions which speak louder than words. A fearless and out-spoken summary of the real facts, however, would do away with the harm of such strange delay, and such a finding, we shall hope to be able to give in our next issue.

THE Baltimore & Ohio and Pennsylvania, this time, have been giving another object lession to employés in respect for law and order. The B. & O. had 150 men engaged (in laying track), when the Pennsylvania appeared on the field with 200 infantry and six pieces of Consolidation artillery, in command of Lieut. Col. JOSEPH T. RICHARDS, of the Pennsylvania Engineers, who put the enemy to rout after a brilliant engagement which would have delighted the heart of the late JOHN PHOENIX, since one of the pieces of artillery was fired bodily at the enemy's breast-works, a pile of ties. Such little pleasantries may seem proper and right to the officers concerned, but they may not seem so funny after the next Pittsburg riot. The responsible parties on both sides should have been put in jail.

Another land-slide on the new Colorado Midland, in rock, has killed eight of ten men, but in new work this is not so remarkable.

THE details of the Boston Common tunnel project have been made public, and involve a tunnel some 1,640 ft. long and 6 ft. under the surface. The tunneling in New York is chiefly in favor of an elevated line on Broadway, and is being actively pushed.


RESERVOIRS
CONTENTS TOGETHER 17660 GALLONS
BOILER
CONDENSER
TUNNEL SUPPLIED BY THE ENGINE AT THE SCHUYLKILL
Drawn by Frederic Graff from the original drawings and memoranda in his possession
Scale of Feet
42 Feet to Low Tide

Section through the ENGINE HOUSE of the

CENTRE SQUARE

WATER WORKS PHILADELPHIA

Building Commenced July 1799
Commenced Erecting the Engine February 1800.
Started the Engine to Supply the City January 21 1801.
Supply from these works discontinued September 7: 1815.
Building taken down 1827

Early American Pumping and Distribution Plant.

We are indebted to Mr. FRED. GRAFF, Past President of the American Society of Civil Engineers, for the material here used in illustrating some early forms of pump, boilers, etc., as set up in Philadelphia in 1803.

BENJAMIN HENRY LATROBE, at a meeting of the American Philosophical Society in Philadelphia, May 20, 1803, says that "steam engines on the old construction were introduced into America about 40 years ago." Among these he mentions two put up in New England before the revolutionary war, and the Hornblower engine at Schuyler copper mine on the Passaic in New Jersey (erected about 1750). The only engines of any considerable power than (1803) at work, as far as Mr. LATROBE knew, were the engine of the Manhattan Water Company, in New York; one at New York used by Mr. ROOSEVELT to saw timber; the two engines in Philadelphia, one for pumping water and a second for driving a rolling and slitting mill, and finally one in Boston, of which he was only generally informed.

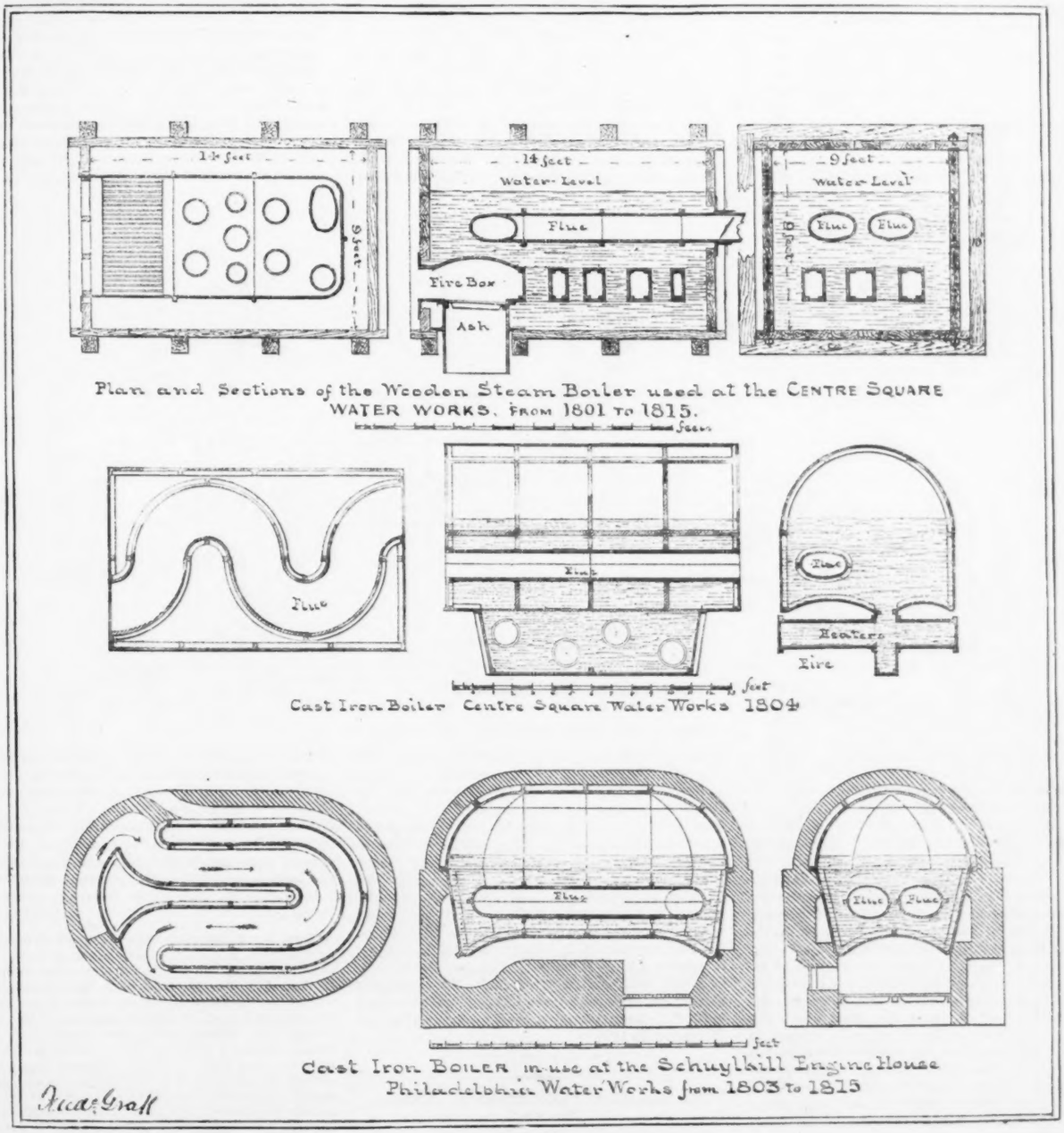
The drawings of the Philadelphia water-works engine, with which this article has to do, were made by Mr. GRAFF from data found among the original documents and plans belonging to his father, FREDERIC GRAFF, Sr., for forty-two years Superintendent of the Philadelphia Water-Works, and immediately connected with them from 1799 to 1847.

The construction of the first Philadelphia engines was commenced in 1800; with B. HENRY LATROBE, engineer, JOHN DAVIS, clerk and FRED. GRAFF, draughtsman. The engines were built at the Soho works, of Mr. NICHOLAS J. ROOSEVELT, about four miles from Newark, N. J. The cylinder for the Schuylkill pumping engine at Philadelphia was cast in two pieces and united by copper with the joint externally secured by a strong cast-iron band 18-in. wide and weighing 1200 lbs. The cylinder was 6½ ft. long by 38¼-in. internal diameter; it weighed about 7500 lbs. when cast, and the boring was intended to cut away ¾-in. of the original metal. This boring was done by power furnished from a 30-ft. water-wheel; three steel cutters, about 3½-in. on the edge, were fitted to the head piece which last was attached directly to the shaft of the water-wheel which was of iron and 8-in. in diameter. This work was slow, as when THOS. P. COPE, of Philadelphia, visited the Soho works in July, 1800, and wrote the official report from which the above is taken, the workman had been boring away for three months on this cylinder and estimated that six weeks more would be required to finish it.

The engine, for which the above described cylinder was being made, was erected on the Schuylkill river at the foot of Chestnut street, and delivered the water to the Centre Square Engine; the cylinder was 38¼-in. diameter and 6-ft. stroke, and drove a double-acting pump 17¾-in. diameter and 6 ft. stroke.

The Centre Square engine, (Fig. 1) built about the same time and at the same place, had a 32-in. cylinder, 6 ft. stroke, and drove a double-acting pump 18-in. in diameter and 6 ft. stroke; it raised the water about 51 ft. into tanks. The Schuylkill engine lifted the water 39 ft.

In both of these engines the lever-arms, the fly-wheel shaft and arms, the fly-wheel bearings, the hot well, hot and cold water pumps, cold water cistern and even the external shell of the boilers, were all made of wood.


14 feet
9 feet
Water Level
Flue
Fire Box
Ash
Plan and Sections of the Wooden Steam Boiler used at the CENTRE SQUARE WATER WORKS, FROM 1801 TO 1815.
Steam
Heater
Fire
Cast Iron Boiler Centre Square Water Works 1804
Cast Iron BOILER in use at the Schuylkill Engine House
Philadelphia Water Works from 1803 to 1815
Fred. Graff

These boilers deserve particular attention at this day. They were rectangular chests (see Fig.2) made of 5-in. white pine planks, of the general dimensions shown. They were braced on the side, top and bottom with white oak scantling 10-in. square, all bolted together by 1¼-in. rods passing through the planks. Inside this chest was an iron fire-box, 12 ft. 6-in. long by 6 ft. wide, by 1 ft. 10-in. deep, with vertical flues, six of 15-in. and two of 12-in. diameter; through these the water circulated, the fire acting around them and passing up an oval flue situated just above the fire-box and carried from the back of the boiler to near the front and then returning to the chimney at the back. This fire-box and the flues appear to have been at first entirely made of cast-iron; then a wrought-iron fire-box was made and used with cast-iron flues; but, finally, on account of unequal contraction and expansion of the two metals causing leakage, wrought-iron was employed for both box and flues.

Great advantages were expected, at this time, from the non-conducting powers of the wood and the vertical flues in the fire-box. Mr. LATROBE says that the wooden boilers had been used in America in distilling for many years, introduced first by a Mr. ANDERSON. But it was found that the "mash" injured the wood, decaying the body of the plank, while the outside was still seemingly sound; it was thought that steam and water would have a less injurious effect. Mr. LATROBE expected to save fuel by the use of a wooden shell; he estimated the heating surface in the Philadelphia boiler at 360 sq. ft., (counting top and bottom of chamber,) and said that the engine could be fairly rated to make twelve 6 ft. strokes per minute for 16 hours in 24, and in so doing consume 25 to 33 bushels of the best Virginia coal. He admitted, however, that the wood above the water-line, effected by the steam only, seemed to loose its solidity in time, and steam-leaks appeared in the joints and bolt-holes. Mr. OLIVER EVANS obviated some of this leakage trouble by adopting a conical hooped wooden boiler to his small steam engine. He also mentioned the fact that the use of oak scantling to support the white pine planks was unfortunate; for in less than a year the pine was badly affected to the depth of 1 in. by the acid in the oak. He recommended the intervention of putty or paste-board, or the use of pine scantling.

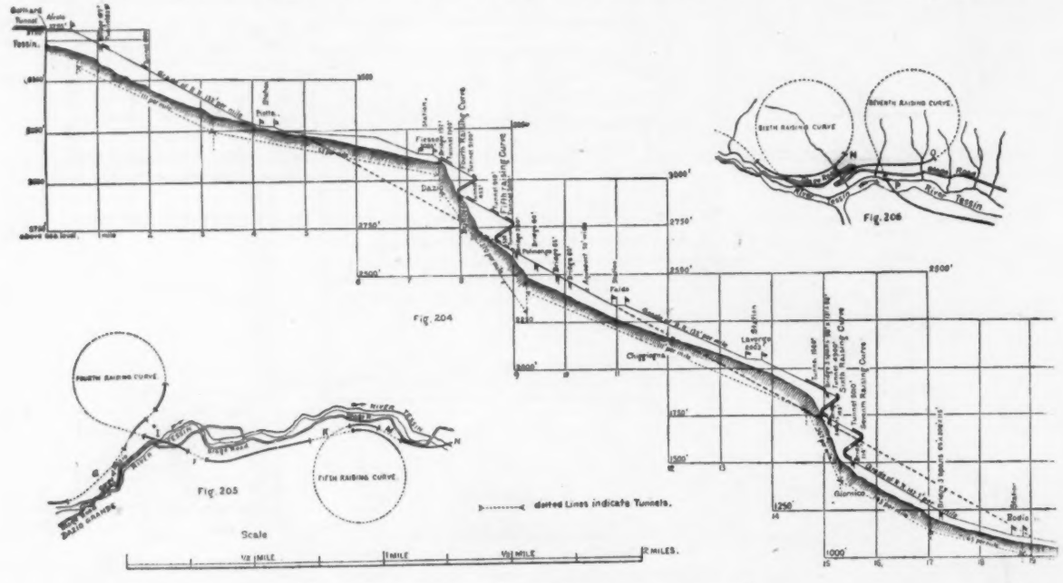
From the record of work done by the two engines, the duty of the Schuylkill engine was 4,790,000 lbs. of water raised 1 ft. high per 100 lbs. of coal consumed; the duty of the Centre Square engine was 4,091,000 foot-pounds. The steam pressure in both cases was 2½ lbs. to the square inch. The Schuylkill engine lifted 1,474,500 galls. 39 ft. high in 24 hours, with a consumption of 70 bu. of Virginia coal; and the Centre Square engine, 962,250 "ale gallons," 51 ft. high in 24 hours, with the consumption of 55 bu. of the same coal.

The Schuylkill engine was started Dec. 22, 1800, and that at Centre square on Jan. 27, 1801. By the contract, made March 21, 1799, they were to cost $30,000 together, but the contractor claimed that they cost him $77,192.

The wooden boilers, as might be expected, failed to give satisfaction, and leaked so much that, on Dec. 1, 1801, a boiler with a cast-iron shell and flues (Fig. 2) was erected; and another, also of cast-iron but different in form, was put in use March 10, 1803. The first was erected at Centre square; it had a semi-circular top, flat ends, and the fire passed under the boiler around heaters of peculiar construction and through a flue of serpentine construction to the front of the boiler. Excepting two sheets of wrought-iron on the bottom just over the fire, this boiler was all of cast-iron.

The second boiler was put up at the Schuylkill works, and Mr. LATROBE described it as follows: The boiler had straight sides and semi-circular ends, and was 17 ft. long and 8 ft. wide at the bottom, and 19 ft. long and 10 ft. wide at a height of 5 ft. 7 in. At this height it was covered by a vault semi-circular in half-section; the bottom was concave "every way," and rises one foot in the center. The fire-box was 6 ft. long by 4 ft. wide, arched parallel of the axis of the boiler, and leaves a space one foot high for the passage of the flames, which last follow the path shown in Fig 2. The boiler was built of 70 flanged plates of cast-iron bolted together, the flanges and bolts being on the water side wherever the flames might otherwise touch them. Mr. LATROBE says this boiler "required a very active fireman," and thought that an increase of 3 ft. in length would have saved fuel. Mr. FREDERIC GRAFF, Jr., says that these last boilers were used until the steam pumping works were started at Fairmount in 1815.

[TO BE CONTINUED].



Profile of St. Gothard Railway, Italian Side.

The Mountain Grades of the St. Gothard Railway.

We reproduce from the forthcoming enlarged edition of "The Economic Theory of the Location of Railways" the accompanying profiles of the mountain grades approaching the St. Gothard tunnel, which are used in that volume as one of the illustrations referring to the laying out of grades. The two grades are famous for the seven spiral tunnels turned into the mountain for the sole purpose of gaining development, and for the enormous amount of other tunneling on the line, as summarized below; but while the merits of the line as a piece of construction are undoubted, and while there were many peculiar circumstances on the line, such as danger of avalanches, absence of lateral valleys, treacherous and very steep surface-slopes, etc., to justify and require peculiarities of location, and especially a large amount of tunneling, yet the facts seem to make it more than doubtful whether the location as a whole can be regarded as anything more than a gigantic mistake. Certainly it furnishes a good illustration of how the long table of the power of engines which we published in our issue of March 12, may be used to great advantage in studying such localities, to avoid possible errors.

The valleys in which both the approaches illustrated are situated are enclosed by high and precipitious mountains, which "consist of hard gneissic granite, in which are imbedded softer strata of micaceous schist," these being the places where the many torrents rises and rivulets have cut most deeply through the mountains. In the lower portions of the main valley, on the Swiss side, these strata become softer, the granite containing more mica, until it in places becomes mica slate. On the Italian side, the rocks are of a more mixed character but of the same general nature. No trouble was experienced in any of the tunnels, nor in the main Gothard tunnel, from water. Immense volumes of surface water flow in many little streams over the mountain slopes from melting snow above, but the character of the solid rock was such that the water did not penetrate through it to any important or appreciable extent in constructing any of the 20.23 miles of tunneling on the two grades illustrated and the long tunnel (9¼ miles) between them. With this preface we may quote from the volume as follows:

"Figs. 202 and 204 are profiles of the bed of the valleys approaching the St. Gothard tunnel, with the scale shown in miles. On the Italian side of the mountain the bed of the stream was broken by cataracts, and it will be seen by the dotted grade-lines plunging below the river-bed that by simply developing the spiral tunnels into straight ones, adding nothing to their length, the same grade up the mountain would have been obtained with a material saving of distance and curvature, and hence, of course, of cost. Such a straight tunnel would start in at the lower portal of the fifth rising curve, near *K*, Fig. 205, and take a straight course through the words "Fig. 205" to a point beyond the limits of Fig. 205, where it would again emerge into the valley, requiring a tunnel of a trifle over 3 miles long, or about what there is now *of tunnel* on the same stretch, saving all the other work and distance. The same is true in substance of the two lower raising curves, or of the upper one at least.

"The fact that this throws the grade-line below the bed of the stream looks bad on the profile, but should not be allowed to deceive. The tunnels plunge into the bowels of vast overhanging mountains of solid rock, and can be kept as far away from the stream as desired, if there were need to consider it at all. The only visible gain from the spiral, therefore, was to have the same engineering curiosities on one side of the mountain as on the other.

"On the Swiss side of the mountain, Fig 202, the spiral developments shown in Fig. 203 were essential for the purpose sought, to reduce the grade to 137 ft. per mile

To have followed the natural grade of the valley would have required from 197.5 to 237.5 ft. per mile grades, according to how closely the bed of the valley was followed. By the aid of the long Table 170 (see ENGINEERING NEWS, March 12) we may see how much real economy in motive-power was effected by these developments in taking the traffic from Silenen to the St. Gothard tunnel. Neglecting the actual distance, which it would be unfair to consider, we may say that the length of the mountain grade in miles would be about inversely as the rate of grade. Then we have, for a heavy Consolidation:

Grade. Ft. Per Mile.	Comparative Length.	Comparative Net Tons.	Load of Eng. Per Cent.	Comp. Eng. Miles Per Through Ton.
137	100.0	319	100.0	100
19⅓	69.3	210	65.9	105
219	62.5	184	57.7	108
237½	57.7	165	51.7	111⅓

would have needed, as above, 10.6 miles, which is about what a line straight down the valley would have afforded. On such a line the passenger speed need have been only two-thirds as great to make the same through time, so that a slight modification of the design of the engine used would have been all that was necessary to handle the same trains. The trifling difference of 5 per cent. in the motive power needed for freight movement has been noted above.

Such an alignment would have released 2.31 miles of mere development tunneling, and saved in all some 4½ miles of costly construction of which about 3¾ miles was in the spirals. The cost of the tunnels was about $575,000 per mile. The cost of the open roadbed $221,000 per mile below Pfaffensprung and $302,000 above it, with $53,300 more in each case for the track and accessories about half for track, and one-fourth rolling stock. Considerable additional tunneling might have been used for protection of roadbed, and yet have left a very material saving both in

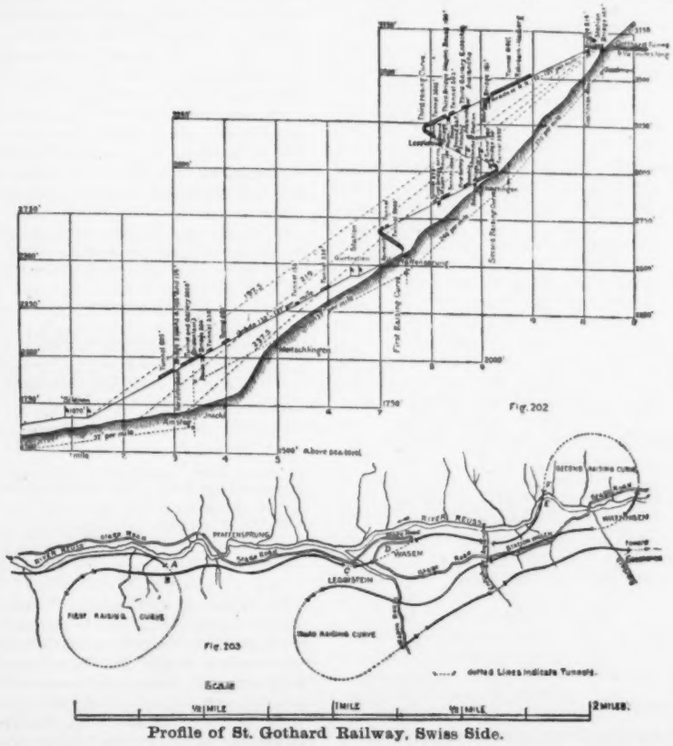


Fig. 202

Fig. 203

Profile of St. Gothard Railway, Swiss Side.

In other words, comparing the constructed grade with the 197.5-ft. grade only, in a valley distance of 10 miles, 4.4 miles $\left(\frac{100}{69.3}\right)$ of *tunnel development* was introduced with the effect of saving only 5 per cent. of the engine-miles necessary to move a car through, and perhaps 2¾ per cent. of the cost of movement. Such errors result from lack of study of the economic side of railway location. There could be no better illustration of the broad distinction between reducing the rates of through grades and of pusher grades stated in paragraph 1017."

The distinction referred to in the last sentence is, that while it is very important to reduce the rate of through grades which control the train hauled over 100 miles or more, although only a few miles long themselves, yet on pusher grades of considerable length and importance, on which the motive power can be adapted to the work to be done regardless of the grades on either side, the particular rate adopted is of small importance; the engine miles per through car remaining substantially the same on all grades below 4 per cent. This we may see more clearly by considering the facts in more detail. On the Swiss side the distances were:

		Miles.
By valley, as shown on profile		9.75
By developed line		15.25
Difference		5.5
Miles of tunnel, spiral	2.31	
other	3.44	5.75

With the same proportion of breaks of grade at stations and on curves, a grade of 197.5 ft. per mile

tunnels and other work, as will be seen at once by remembering that the spiral tunnels did not serve at all for protecting the track, and by noting on the profile how considerable a part of a steeper grade might have been placed in tunnel by developing their 2.31 miles into straight tunnels.

On the Italian slope the case is still clearer. No increase of ruling grade is needed to take out the spirals. The distances were:

		Miles.
By valley, as shown on profile		19.
By developed line		24.1
Difference (3.75 miles by spirals only)		5.1
Miles of tunnels, spiral	3.80	
other	1.43	5.23

Here very little tunneling was needed except for development, and the only effect of the development was to climb up over waterfalls at one point, so as to give a broken grade instead of a straight one. At Fiesso or Dazio, for example, is one of the wildest gorges in Switzerland. There were 2 miles of development tunnel there, which advanced the line nothing, with half a mile of other tunnels. A little over 3 miles of *straight* tunnel would have been sufficient to pass by the gorge completely, saving all the cost of constructing and operating several miles of track, with no disadvantage to the ruling grade.

At the sixth and seventh rising curve is a similar point, with the difference that the same grade is not resumed both above and below, if both rising curves are taken out. We therefore need not consider it in detail, as there might have been circumstances which are not apparent in the detailed maps, profiles and descriptions of the line which lie before us*, why this would have been objectionable. This does not seem to be the case with the remaining points mentioned. It may be added that no attempt has been made in the dotted profile of the Italian slope to provide easy grades for stopping points simply because it did not seem essential to enter into so much detail.

The cost of the work on the Italian side was about $590,000 per mile for the minor tunnels, the main Gothard tunnel having cost $1,300,000 per mile. Apart from tunnels the work cost $124,500 per mile above Fiesso, $265,000 per mile below Lavorgo, and $200,000 per mile on the middle section, with the same addition as above for track and accessories.

The total cost of the work, all told, was about:

Main tunnel with track complete	$11,800,000
Two approaches of 39.35 miles	15,830,000

an average of about $403,500 per mile for the approaches, which may be again divided as follows:

	Total.	Per Mile.
8¾ miles of spiral developments	$4,690,000	$536,000
31.1 " " approaches proper	11,140,000	358,000

The money which went into the spirals, if our conclusions have been correct, was an almost useless investment. Of the remainder, if we seek an explanation of the enormous cost per mile we shall find it chiefly in the limit of curvature adopted, which was 300 metres (984 ft.) radius, or about 5° 48'. How much it would have reduced the cost had 10° or 12° curves been the maximum it would be impossible to even guess, except that it would have reduced it enormously, and in view of the perfect ease and safety with which such curves are operated in this country, and even far sharper ones, as is illustrated in a measure by the cuts of the New York Elevated railway curves, which we gave recently, it is apparent that no claim that a better article was wanted and hence a better price had to be paid for it, is not sufficient to justify or explain such a contrast. A vast sum was spent to obtain something which was worth little or nothing after it was obtained, either for safety or economy in operation. The most which can be said therefore in contemplating these features of the design, is that it is magnificent, but it is not civil engineering; for civil engineering consists in accomplishing desired material ends in the best way.

In connection with the preceding data as to the St. Gothard line the following data as to the cost of the Mont Cenis and Brenner Alpine lines will be of interest.

The maximum grade of the Mont Cenis Railway is 158 ft. per mile, which is reduced in tunnels to 116 ft. The sharpest curve on the Italian side is 3° 30', and on the French side 4°, 23' and 5° 25'.

Open line, $2,373,933 or, per mile		$263,770
Tunnels $1,117,760 " " "		693,400
Total line $3,491,693 " " "		$329,405

These figures correspond very well with the cost of the most difficult portions of the St. Gothard Railway.

The cost of construction on the entire Brenner line from Innspruck to Botzen, 77.9 miles (74.83 miles open line and 3.07 miles in tunnel) and exclusive of track, etc., as above, was $10,562,256 divided as follows:

Open line $8,516,223 or per mile		$113,800
Tunnels 2,046,033 " "		664,462
Total $10,562,256		$135,587

Mr. WILLIS GAYLORD, M. P., in a letter to Mr. S L. FOWLER, President of the projected Reading and Chesapeake Coal and Railway Company, states:

"Some of my American friends are now building and operating a railway with steel ties in Africa. The cost here is about the same as wood—say $1.15 each—but they rust out rapidly, and the weight of ties per mile of track is equal to the weight of rails per mile

Dr. SEIMENS is now preparing to deliver large quantities of his toughened glass ties, after repeated trials and most satisfactory results. These glass ties does not rust, and if broken can be sold at any glass works with less loss than on sale of old steel ties.

The glass ties withstand as heavy blows and usage, at any temperature, as cast-iron will. They are lighter in weight and more durable than steel, and equally saleable when broken. 1,000 old glass ties weigh as much as 1,000 new ones, but old steel ties are very much reduced in weight by rust, etc. The glass tie seems destined to be the tie of the future."

*Tracé et Profil en Long du Chemin de Fer du Gothard, avec Devis approximatif. Rapport fait à la Direction par W. HELLWAG, Ing. en Chef du Ch. de F. du Gothard. Text and Plates. Ovell Füssli & Co., Zurich. E. & F. N. Spon, London and New York.

Nantucket Harbor Improvements.

DISCUSSION BY PROF. L. M. HAUPT.

In ENGINEERING NEWS of Jan. 8, there is given a map, and description of the project for increasing the depth of water at this important harbor for coasters. The approved plan, as therein stated, is to build two converging jetties of rip-rap stone, "so arranged as to concentrate the strength of the tidal current, and excavate a deep channel by scour." Up to June 30, 1884, 3,515 lin. ft. of the western jetty had been built at a cost of $88,181.11 without apparent effect on the bar, and it was estimated that $265,000 would be required to complete the existing project.

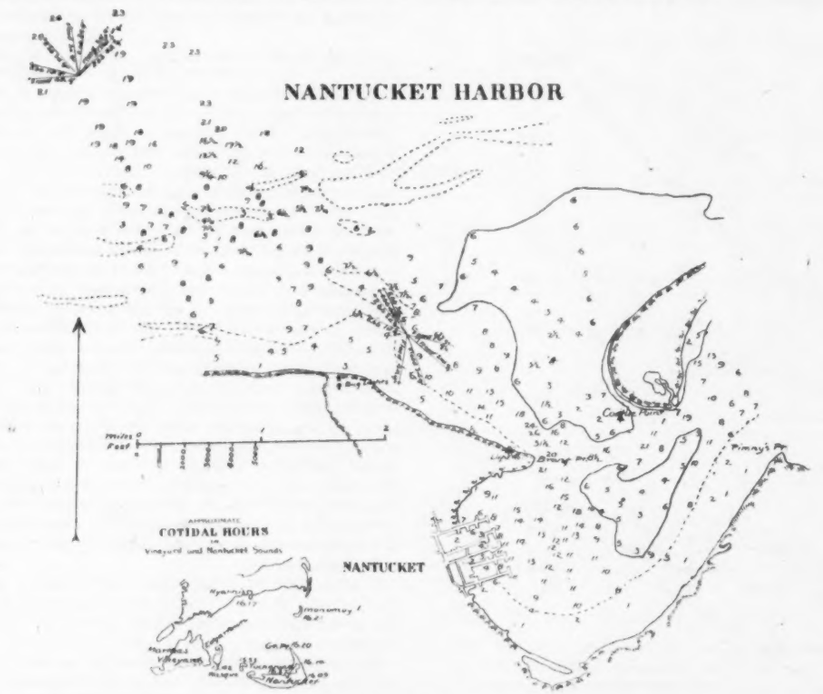
BASIS OF THE PLAN.

As this improvement is based upon utilizing the "strength of the tidal currents" it becomes necessary to determine their relative intensities, duration and directions. To this end the argument in favor of the proposed second jetty has been carefully examined, and it appears that the data obtained from actual survey are very meagre and unreliable because of "swirls and eddies in the throat of the harbor" and because of stormy weather and rough water, but the results show that "the highest bottom velocities observed were about 1.6 and 2.1 ft. per second on the ebb and flood respectively, the mean bottom velocities were about 1.2 and 1.5 on the ebb and flood." This shows the flood to exceed the ebb velocity at the gorge. The result would be to move sand into the harbor and not out on the bar. This appears to be confirmed by comparing the U. S. C. S. chart of 1848 with that in the Report of the Chief of Engineer's for 1885. The former shows a hillock, just inside the entrance, where the flood currents separate and the ebbs unite, with from 6 to 8 ft. of water; the later map, at the same point, shows but 1.4 ft.

Notwithstanding these results it is stated in the argument already referred to that "The success of the jetty system at Nantucket would seem, therefore, to be doubtful, but it is universally conceded that the scouring effect of the ebb is superior to that of the flood tide (although the cause of it is only surmised) and even in such an unpromising case as Nantucket may appear to be, the resultant of the outward or forward movement of the material of the bed of the channel during the ebb, and the inward or backward movement during the flood, may be assumed to be outward." It appears then that the success of the plan is regarded as doubtful and that the plan itself is based upon the *assumption* that the resultant of the ebb and flood scour is outward.

The best evidence on this point is that furnished by the bar itself. If the scour is outward then the movement of the sand up the inner slope or ramp, must be opposed by gravity, while on the outer slope it would be aided by gravity, hence the section of the bar would show a gentler slope inside; if the scour is with the flood the reverse will be true. The maps of 1848 and '85 both show that the inshore slope is the steeper, and hence indicate a slight excess of *flood* scour.

The direction of the flood outside of the bar is very erratic; at 1st quarter it is N. E.; at 2nd quarter N. E. by N. 0.3 M.; at 3rd quarter W. of N. 0.3 M.; and at 4th quarter nearly W. while the harbor entrance is about S. E. from this station. The ebb at this point ranges through the same quadrants, and has the same velocities 0.3. M. Inside the crest of the bar the flood sets *towards* the entrance, and swings from S. of East to W. of South, 90°.



Nantucket Harbor; from Coast Survey Chart.

RESULTS OF THE SECOND JETTY.

If completed as projected the gorge between the two jetties will be 1,000 ft. wide, and 6 ft. deep at M. L. W., giving an area of 6,000 sq. ft. through which to admit the flood tide, as compared with the present section of say 24,000 sq. ft. between Brant and Coatuo Points, or only 25 per cent. As the general set of the tide is off shore this contracted entrance would merely receive the overflow, as through a weir, from the tidal current which may pass its mouth, and hence a much smaller volume would flow into the harbor through it, than through the present natural entrance.

As the times of ebb and flood are here equal, and as the former is not augmented by any land drainage, this reduced prism of discharge would be correspondingly enfeebled while the work required of it would be increased, since it is obliged to change its direction, and so lose a part of its energy. The result of the pair of jetties would be to dam up the entrance, and destroy the harbor by reducing the velocities of its inner currents.

REMEDIES.

As Nantucket is situated at the point of interference of two tidal waves, the case is anomalous and the forces available for improvements by tidal scour are limited; still there are two ways in which good results may be attained; the one, external; the other, internal. The harbor is composed of two bays, parallel with the shore, the western one about three-fourths of a mile long, the eastern about six miles, hence the latter contains the greater prism of discharge and the paths of its currents indicate that a portion of its waters flow over into the western bay to supply the place of that drawn out by the main discharge through the gorge. The discharges from the two bays are directly opposed to one another, and hence before they can unite in the resultant under Brant Point, they both lose a part of their inertia in joining and changing direction. The main discharge from the west bay is turned nearly 90.° This resultant direction may be given to the separate stream by a properly placed mass of inert material and so the energy of the ebb discharge from both bays may be conserved without permitting the present interference and without opposing in the slightest degree the fundamental requirement that the flood *should have free ingress.*

The external treatment is one which would also permit the flood to enter freely and which would concentrate the ebb, both laterally and vertically upon the crest of the bar!

The suggestion which has been made to cut a channel through "haulover" beach would be disastrous to the harbor, as the flood tides would meet in the east bay and produce shoals.

Numerous interesting data bearing upon this intricate problem have been omitted, as our space is restricted, but it seems clear that even a good harbor at Nantucket will not change the direction of the winds which make this shelter so desirable. The interests of navigation would doubtless be far better served by cutting the canal through Cape Cod and thus rendering the passage both safer and shorter.

NOTE.—From 1829 to 1832, about $40,000 were spent in dredging a channel through the bar at Nantucket, but not a vestige of this work remains. This method as an external remedy is out of the question.

On the Best Manner of Making Use of the Services of Experts in the Conduct of Judicial Inquiries.

BY CLEMENS HERSCHEL, C. E.

"Periti potius judices sunt quam testes" A common expression with law writers of the Middle Ages.

"Et generaliter unicuique in arte sua experto credendum est."

DURANTIS, A. D. 1237-1296.

(*Continued from page 235.*)

In discussing the method of making use of expert knowledge in judicial inquiries prevalent with us, it should be borne in mind that it is a comparatively recent method, but little more than one hundred years old. To the civil engineer it is extremely interesting to observe, that the individual referred to in the law-books as "a Mr. SMEATON," who was called as a witness in the leading case of FOKES *v* CHADD (1782), and whose opinion was thereupon admitted by Lord MANSFIELD, was none other than the well-known JOHN SMEATON, F. R. S., the distinguished builder of the Eddystone Lighthouse; the man who first signed himself "Engineer," or "Civil Engineer," in Great Britain; thus, the founder of the profession, in English-speaking countries, or the first English civil engineer; the builder of the first of modern light-houses; and, as it would seem,—following the developments of English law,—the first expert witness. In "Some Account of Life, Character, and Works of Mr. JOHN SMEATON, F. R. S.," prefixed to Vol. I of "Reports of the late JOHN SMEATON, F. R. S., made on various occasions, in the course of his employment as a civil engineer," (London, 1812), his contemporaries, a committee of whom published the three volumes and a supplemental volume of this work, thus speak of him: During many years of his life, Mr. SMEATON was a constant attendant at Parliament, his opinion being continually called for. And here his natural strength of judgment and perspicuity of expression had their full display. It was his constant practice, when applied to, to plan or support any measure, to make himself fully acquainted with it, and be convinced of its merits, before he would be concerned in it. By this caution, joined to the clearness of his description and the integrity of his heart, he seldom failed having the bill he supported carried into an Act of Parliament. No person was heard with more attention, nor had any one more confidence placed in his testimony. In the courts of law he had several compliment paid to him from the Bench, by the late LORD

MANSFIELD and others, on account of the new light he threw upon difficult subjects."*

It must be very evident, then, that the conditions of presiding justice and proffered witness were very favorable for a swerving in favor of the establishment of the species; expert witness in FOLKES *v* CHADD, though at the time it was really a man of great renown, whose *dictum* had great weight undoubtedly with both sides, and confessedly with the presiding justice, that was allowed to address the court from the witness stand. The older practice was, however, palpably different. In this very case of FOLKES *v* CHADD, Lord MANSFIELD cites from the Year Books a case where, in a question involving a knowledge of the civil law, the judges were "well content to hear *Huls*, who was a bachelor of both laws, argue and discourse upon logic and the difference between *compulsione præcisa et causativa* (the case was about a matter of divorce), as men that were not above being instructed and made wiser by him;" and another case where, in an appeal of mayhem, "the judges of our law have been used to be informed by surgeons whether it be mayhem or not, because their knowledge and skill can best discern it." (Case of BUCKLE *v* RICE THOMAS, Plowden's Com. p. 125.) So in a case in 1718, where a will was "writ blindly and hardly legible," it was referred to a master, and "he to be assisted by such as were skilled in the art of writing." MASTERS *v.* MASTERS, 1 P. Wms. 420). So also, in a very early and curious case, tried two hundred years before Lord MANSFIELD'S time, where the meaning of the Latin word *licet* was material to the proper solution of the cause, SAUNDERS, Justice, said: "And first I grant that if matters arise in our law which concern other sciences or faculties, we commonly apply for the aid of that science or faculty which it concerns. Which is an honorable and commendable thing in our law. For thereby it appears that we do not dispise all other sciences but our own, but we approve of them and encourage them, as things worthy of commendation."

Note that "the *judges* were well content to hear *Huls*;" and "the *judges* of our law have been used to be informed." It is right here, as it would seem, that the English practice apparently took a diverging course of development from that taken on the Continent. There the plan of having the expert called by, or asked to serve, the court or the judges, has been further developed, and is now an established procedure: though experts called by the parties have been known there certainly for six or seven hundred years, and are yet in use; as they must always be, together with court of judicial experts. At the same time, men learned in the law assure me, that the power to call expert witnesses yet lurks within the arsenal of any equity judge under our procedure, at least in England, but has not been exercised for possibly more than a hundred years.†

And that the courts could, if they had chosen, have so shaped matters as to be now able to call experts for the enlightment of the jury also. Be that as it may, legislation could evidently at once put it within the power of either party to cause the presiding justice or to enable the presiding justice of his own motion, to summon an expert for his opinion on certain questions, or to summon a jury of experts.

It seems advisable, however, before venturing to suggest methods that would tend to an improvement of the present procedure, to come to some definite understanding as to the object to be attained. I had supposed that all men were agreed in this: that the object of all courts was the furtherance of justice, and that justice would require for its absolute attainment not only all possible enlightenment, but even omniscience; that it was a mockery of justice to seek it by any way, but by way of the truth; that perfection should be the aim of all men, in all the walks of life, of the ministers of justice, no less of other servants of mankind. And I cannot bring myself to take any other view of the matter, in any case, the reasoning of a noted writer on criminal law to the contrary notwithstanding.

Mr. FITZJAMES STEPHEN, in his "General View of the Criminal Law of England," has argued at length on this point, though careful to restrict it in its application to criminal cases only. Alluding to a suggestion that instead of allowing expert witnesses to be called, the court refer scientific questions to experts, he says: "Apart from the difficulties of detail and practice which would be involved in the adoption of any such plan, it proceeds, I think, upon a misapprehension of the result to be reached and the mode of reaching it. It assumes that the object of the inquiry is the attainment of truth simply, and that scientific men are more likely to attain it than others. To this it may be replied, that the result to be reached is not the truth simply, but such an approach to the truth as the average run of men are capable of making, and that this result is more likely to be found in the opinions of common than in those of scientific jurors. . . . A juror is not a scientific inquirer, but a judge bound by oath to say whether or not certain evidence satisfies his mind. A scientific enquirer is not bound to anything of the kind. He may pursue his subject as long as it suits his inclination, and may drop and resume it at pleasure, as the interests of truth may require. It is his object to arrive at the truth simply." So that we find the scientific inquirer scornfully rejected, because "it is his object to arrive at the truth simply," which is said not to be the object of the inquiry, while others have said, that "it has often disturbed and distressed sensitive minds, when seeking to ascertain what the truth was, to be obliged to resort to the opinions of men (experts) who have seemed to regard their line of duty as lying in the direction of the success of the one who employed them, rather than the discovery and establishment of truth." But Mr. STEPHEN is best answered in an article on a "Court of Inquiry into the Medical Evidence of Crime" (20 "Law Magazine and Review," 272), by J. CAMPBELL SMITH, Jr. Says that author: "But I maintain that the result to be reached by the trial is not only 'such an approach to the truth as the average run of men are capable of making,' but, on the contrary, the nearest possible approach to the truth. . . . We cannot be absolutely certain that any verdict, however carefully formed, is true; but we can take such measures as are within our power for attaining the nearest possible approach to the truth."

Had we followed Mr. STEPHEN, we should have found ourselves justifying, with him, the burning of witches, for the time when it was done; instead of deploring it as an enormity due to imperfect sociological conditions, such as an imperfect administration of justice, amongst other causes, and as something the like of which should be guarded against and rendered impossible in future years, rather than be excused and rendered possible of repetition, as would be possible, it seems to me, under the rules laid down by the learned author. In fact, I cannot see why the same train of reasoning will not justify the performances of "Judge Lynch" in the Southern or in the Western States, especially in their earlier days; or the proceedings of the "Vehm-Gericht;" or many other miscarriages of justice; very popular, no doubt, and stamped with the approval of the large majority, in the time of their occurrence, but a miscarriage of justice none the less. Such a subject as this I should not want to discuss with a law writer; but as the learned author himself does not think highly of allowing experts to decide upon matters within their especial knowledge, he cannot complain when a layman refuses to be guided by him in considerations of law, and, siding with the learned writer on the other side, sets down as the object of any and of all judicial inquiries the attainment of "the nearest possible approach to the truth." And with the establishment of this object of all judicial inquiries, fall to the ground any objections made to experts called by the court, whether in civil or in criminal cases, by reason of their being too much imbued with the natural desire of the scientific inquirer to arrive at the truth simply.

We may assume, then, a judicial inquiry in progress; its object is the attainment of the truth; a question of expert knowledge has come up; an expert is within calling distance, and is to be asked to give his opinion upon it. And it may be argued that the same self-respect which would prevent any one in private life from giving his opinion in a mixed assembly, unless there were a general desire to hear it, naturally disinclines the expert from giving it in court, unless he be asked for it by all parties. If it be replied, How does it then happen that experts are found in such numbers to testify in court? I reply that probably all of them commenced under the mistaken notion that all parties were desirous of getting their opinion; and by the time they have become disabused of that idea, they have either been rendered callous to such fine, though eminently proper, feeling, or they much prefer to stay away. Nor can the expert make any proper approach to the attainment of the truth, unless he be left to pursue it in his own untrammelled way by all parties.

Again, should the expert be moved by a "desire to present fairly the truth of the case," in his opinion about to be given, it is essential for the attainment of that object that he be very choice and circumspect in his conduct and in the selection of his surroundings. These same conditions are necessary, also, in order that the opinion about to be given have weight with the recipients of that opinion. Unless parties have in some form requested an opinion, they are, however, at the very outset made incapable of properly receiving it, or of giving it that weight which may justly be due it. I believe I state the matter fairly, when I say that the value, or utility, or effectiveness, of an opinion springs more directly from the frame of mind of the recipient, than it does from the capabilities and the uprightness of him who has rendered it. Any one who has ever conscientiously tried to arrive at a fair opinion, and at an opinion which he desired should also seem fair and carry weight, can fully appreciate the force of the statement just made. How then can it be possible for the expert to inspire that respect which is the proper attribute of any honestly formed opinion, and through which respect alone it can have utility, when such opinion must be formed after private consultation with counsel and his clients, and a life of months, may be, in the midst of the peculiar atmosphere which surrounds one side of a case? Of what weight would the opinions of our wisest and most worthy justices be, were they formed in such an environment, and enunciated under direct and cross examination? Could it not rather be said, that under such a system there would at once cease to be any of the respect we now most properly feel for the judiciary, and is it not certain that the admirable qualities we now esteem in the learned and upright judge could then find but meagre development? Turn and twist this matter as one may, it seems to me that here is an irrepressible conflict: to testify as a witness is one thing; to give a deliberate expert opinion is quite another thing. And in order that the last-named process may have value in the conduct of judicial inquiries, it is an essential preliminary condition that such opinion shall have been asked for, actually, or by fiction of law, by all the parties in court; or else by the tribunal of justice, only. Such is the method of the older English, and a marked feature of the present Continental practice; which last, I believe to be very similar in all the Continental countries.

(TO BE CONTINUED).

Mr. ANDREW CARNEGIE recently had an unusual welcome from his 2,000 employés. Shortly before the train passed the station extra fires were placed in the furnaces, the electric lights were turned on, every natural gas escape-pipe in and around the mill was lit, and the flames from the blast furnaces shot higher than ever before. A constant shower of sparks was forced 100 ft. into the air and rained down over the mill, making one of the grandest pyrotechnic displays ever witnessed.

About 200 boys, each waving a lantern, stood on the platform of the station and cheered until they were hoarse. Every steam whistle was turned on, and steam escaped from every point possible. About 1,000 of the men were ranged in front of the mill, some with lanterns and others waving their hats. The only thing lacking to complete this demonstration was the presence of Mr. Carnegie himself, who was unexpectedly delayed.

JUDKINS' electric train signal, a substitute for the bell-cord, has been introduced on trial on the Grand Trunk, with reported satisfactory results.

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*In Vol. III. is Mr. SMEATON'S report on Wells Harbor, under date May 4, 1782, which commences thus: "Having carefully inspected the present condition of the Harbor of Wells in the County of Norfolk, and the Slade Marshes, and other premises, the object of a suit, wherein Sir Martin Brown Folkes, Baronet, and Robert Hales, Esquire, were plaintiffs, against George Chadd, Esquire, and other defendants, and having also carefully inspected the several plans and papers that have been produced in evidence in the said cause, the following facts, drawn from my own view of the premises, and in part from the evidence produced, appear to me to be very well ascertained and agreed upon."

†"Sir GEORGE JESSEL, the late Master of the Rolls, a few years ago, asserted this power, but added that for one reason and another he had never exercised it." Extract from a private letter.

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The last report of Secretary Whitney tells us that in six years this country will possess only three serviceable cruising ships of war, unless immediate action is taken in completing the vessels already authorized. But if we have no ships, the same report consoles us with the statement that we do have, stored up in our various navy yards and kept in the best of repair,—46,566 augers and bits, 29,542 gross of screws, 146,385 files, 11,813 paint-brushes and cut nails enough "to last fifty years." We fear that this material, even used as projectiles, will have little effect on the iron sides of a possible foe, and, for the same reason, the augers would be of no avail in perforating the bottom of an attacking ship-of-war.

The statement of the weather of the United States for March, which appears in this issue, is calculated to upset some current ideas as to this unpopular month. Neither the average nor the maximum velocity of the wind was as great as in the month before, as appears from the following comparison of the velocity of the wind:

	Vel. of Wind. Average.		Miles per Hour. Maximum.	
	Feb.	March.	Feb.	March.
19 Northern Stations....	8.36	7.92	37.0	35.4
6 Southern "	8.59	7.91	35.3	30.4
7 Far West "	7.37	6.51	36.8	29.6

The extreme velocity at any point in each group was about 44 miles in March, and 46, 45 and 64 miles in February.

The contrast in rainfall (mostly snow) is very notable in this month between the interior and coast cities: much more so than the average of the year, being as great as between 3 or 4 in. and ½-in. Fort Yuma, of soldier's blankets fame, did not indulge in any rain either this month or last, and in a large number of the interior points most of the rain or snow that did fall, fell on a single day.

Fort Yuma did indulge, however, in the hottest weather of the United States for the month, 92.2°, the other extreme being —15.7° at Bismarck, a range of 107.9°. These being the extremes of our whole continental area it is interesting to note how nearly this limit is approached at multitudes of interior points which have a range of over 50°. New York City has the least range east of the Pacific ocean. The charms of the Florida climate do not show up conspicuously.

By following these records from month to month an idea of the climatic conditions in all parts of the country can be easily obtained which is likely to be a useful bit of knowledge in many ways.

Every great catastrophe may be relied upon to bring forth a multitude of new and startling facts. The "Tin Bridge" is proving no exception. Prof. Geo. L. Vose, whose new work on "Bridge Disasters, their Cause and Remedy," (we quote the title only from memory) has been announced since it fell, has recently been making some remarkable statements of this character which only lack a basis of fact to rest on to be very important indeed, and which demand correction. In a letter to the *Boston Advertiser* of April 11, 1887, he states:

"In spite of the inspection made by state authority 200 railroad bridges have *broken down* in the United States in the past ten years, and at the present time the rate is not decreasing."

This is at the rate of 20 per year, and while it is true that 20 so-called "bridges" came to grief in one way or another during the past year, yet when we check it over we find they were divided as follows:

Wooden trestles (not bridges at all, in any proper or usual sense of the word)	7
Accidental blows from badly loaded cars	1
Abutments washed out by freshets	3
Wooden bridges destroyed by fire	2
Bridges destroyed by derailments	4
Bridges which failed for unexplained causes (in no case specified that they fell from inherent defects, without other provoking cause, which is strong evidence that they did not)	2
Total	20

Here it will be seen that *perhaps* one or two bridges fell from inherent defects which inspection would have cured, but there is no positive evidence that even one did. As a matter of fact, it is a very rare event for iron bridges to fall in that way. It is surprising that it should be so, but it is so. There are more fall than there should or than there need, but nothing is gained by exaggerating their number so greatly, even if it were justifiable to do so, that good might come.

One of the readers of Engineering News sends us an anonymous communication in reference to the Bussey bridge. We cannot publish nor pay any attention to such communications.

At a time when we are only commencing to arm ourselves with modern guns, protect our ships and forts with modern armor-plate and are ransacking Europe for the best models of each, the success of the Hotchkiss gun in England and on the Continent is rather a bitter commentary upon our lack of appreciations of home talent in gun-designing. This gun was invented by an American in America; but failing that recognition at home that its merits warranted, the inventor took it abroad and there made it the gun of its day, the destroyer of the much feared torpedo-boats and the superior in effectiveness of the 80 and 100-ton monsters that were powerless behind all their armor-plate against the attack of this quick moving foe. We must have it in our new ships and must now practically borrow from a foreign nation what was once solely our own. Commercially the gun has been no less a success, as the profits of the St. Denis Co. year were last $925,000.

We have received from the Société Cockerill, of Seraing, Belgium, through Mr. C. P. Sandberg, a sample section of the Goliath (100 lbs. per yd.) rail recently designed by Mr. Sandberg. It is certainly an impressive bit of steel, and while we cannot altogether approve of the details of the section, it would probably be well for our lines of heavy traffic if they had such heavy sections in extensive use, assuming proper care were taken to insure good quality by a real, and not merely superficial inspection. The Société Cockerill also authorize the statement that if any one wishes to try a sample lot of these very heavy sections, they will be furnished at current rates without charge for the rolls.

A "Union" Engineering Library,

There are now three great engineering organizations, of a national scope and character, having their headquarters in this city, the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining Engineers. The first is the only one having a building of its own, and any apology for a technical library, but the Mining Engineers outnumber it, and the Mechanical Engineers have probably more rich men among them with an interest in science. There is also a young national society of electrical engineers, which is likely to grow, and an American Institute of Architects with headquarters in this city. There are in addition quite a number of minor scientific organizations.

Two or three years ago a movement was started which resulted in the appointment of a joint committee of the three leading societies to devise, if possible, some plan for a joint engineering library supported by the three societies on some equitable plan, which should ensure payments in proportion to benefits, and save the waste of force and means resulting from a duplication of books and of library employés. A more reasonable project, from this point of view, there could not be. A thoroughly adequate library for the uses of either one of the three societies should contain almost the same books, since there would be hardly any books which one society would certainly need which members of the others might not have occasion to consult.

The joint committee held several meetings, but, as is so apt to be the case with the work of committees, nothing came from it, even in the way of recommendation. For a long time, the project has been almost wholly in abeyance, but the last issue of the *Engineering and Mining Journal* brings it to the surface again and makes a strong plea for it; summarizing the undoubted arguments in its favor, declaring with cheerful confidence that "there is, we are convinced, a *strong sentiment* among the members of the several societies in favor of such a union of effort," and declaring with undoubted truth that "it would not be difficult to arrive at a *just* basis" for such coöperation. The difficulty of finding a basis on which all will agree remains however.

We should be glad, to the extent of our power, to aid our contemporary in having "the subject discussed," and in bringing about that most desirable end: the formation in this city of some approach at least to a good technical library, for the condition of the city in that respect is little short of a scandal and reproach to its men of scientific pursuits. The best that it has to offer is so poor that there are scores of volumes in many private collections which are not to be found upon the shelves of any public or society library in the city. We could readily pick off a dozen from the scanty book-shelves of this office, nor do we mean to refer to rare or costly works, but to current engineering publications, such as cost

JAMES BUCHANAN EADS.

little or nothing and are indispensable to make a reference library worth consulting.

And yet there is no city in the country where there are even a third as many people who are likely to have need to consult such a library as in New York. Boston has three or four libraries which are stronger than the strongest in New York in technical books. Philadelphia has in the Franklin Institute library a really fine collection, well cared for and well maintained. Washington and Cincinnati are at least better off than New York, and Chicago soon will be.

Something ought to be done, but we shall not do it any sooner by shutting our eyes to facts, nor by underrating and obscuring the obstacles, and there are very serious obstacles to the coöperative plan, which our contemporary does not touch upon. The first and greatest one is that that there is no such "strong sentiment" as it assumes in any one of the three societies in favor of the project. There is none against it, but there is plenty of that most fatal of all opposition—indifference. "To assure me that the influence is gone," said a great divine, "give me not your opposition, but your unconcern." That such "unconcern" exists as to the library project is clearly shown by the fact that the societies, not only do not "hang together" in the matter, but they do not "hang separately." As engineers, we are all supposed to be familiar with a certain axiom as to the whole being equal to the sum of all its parts, and as neither one of these societies takes much interest in its own library, which it has seen, how shall it take an interest in a "joint library," which it has not seen? It is beginning at the wrong end to attempt to unite them in an effort for which they are not separately ripe. Let any one of the societies, and especially the oldest one, which has already a fair foundation, show a real interest in the matter, and the others will fall in readily enough, either individually or collectively, but to create that in some *one* society should be the first effort. What is every one's business is no one's business. There would be a certain loss of individual interest as well as gain from greater numbers, in such coöperation, and we fear the joint library would languish, for we know of no precedent for such joint effort which is encouraging.

That there is as yet so little interest in the library question as to amount to nothing, is shown in several ways. A vast amount of technical matter, and some of the most valuable, is to be had for the asking, in government, state, city and corporate publications, reports and pamphlets. Engineering is peculiar in that respect. A large amount of its best material is so published. To this add current technical periodicals, plans and photographs of engineering works, and natural accessions from bequests and gifts, and the foundation for what will soon become a most valuable reference library is laid at once; but if there be a society in this city which is systematically collecting such matter we do not know of it. It requires time and care rather than money to do so; but it requires some money, and it is not reasonable to expect the secretaries to do it without some specific action by the societies in that direction. Assuming such action to be had, a few hundred dollars per year to purchase simply the most important and necessary current publications will keep the deficiencies of the library from becoming conspicuous. Until some society is willing to take this much trouble for itself alone, we see no hope for the joint project.

The first thing to do is to create this interest, and we are satisfied it can be done by any two or three men who will go about it in earnest. That society will add greatly to its prestige which does it first, and its own interest will be apt to kindle a corresponding one in time among men of means who would be glad to help along such a library. But there must be fire to start fire, as a rule.

The Brooklyn Bridge Problem.

The trustees of the Brooklyn bridge find themselves confronted with a very serious problem. To speak with more literal exactness, they are so confronted, although they hardly seem to have found themselves there yet, for they still pursue a merely temporizing policy in regard to a difficulty which will soon become very great indeed. If anything may be predicted with certainty, it is that the stream of travel over the Brooklyn bridge has but begun to flow. Every year, so far, it has increased greatly; every year, during this century at least, it is likely to increase. The structure itself is capable of carrying over millions daily in safety, and its enormous cost seems to require that it should do so, if in any way possible, rather than that another bridge should be built within a mile of the present one, and a structure more than a mile from it, will relieve it but little.

And yet it is claimed with good reason, that almost the last step possible to increase its capacity under the present system of operation has been taken this week, in substituting four-car for three-car trains. At 10 miles per hour (15 ft. per second) and 90 seconds headway, there is only 1,350 ft. between trains. Allowing 45 seconds for unloading (and no less is reasonably possible) the next approaching train is within little more than 600 ft. when the previous one is switched away from the platform. To increase the speed to 15 miles per hour would diminish the headway to 60 seconds, and bring one train almost upon another before it could be unloaded, for to the speed of unloading, when cases of invalids, children and clumsy people are included, there is a positive limit. Therefore the trains can never be run on much less than a minute headway for this reason alone, and such short headway would not now be safe.

By the use of some special form of hydraulic interlocking apparatus, however, which would introduce some form of protecting hydraulic buffer behind a discharging train, of sufficient strength to receive and resist without undue shock the moderate impact of a train approaching at 10 miles per hour, such headway might be permitted, and whether it is obtained by increasing the speed or the number of trains, will make no difference in the capacity of the bridge. Probably something of this kind will be the next step taken to increase the capacity of the bridge, but even then, the capacity has only been increased 50 per cent., allowing that the present inconvenient crowding continues. The traffic will soon outgrow this increase, and the only remaining resource will be to increase the number of cars. In this direction also the possible limit under present arrangements will soon be reached, if it has not been already. Switching room cannot be had to switch much longer trains in the ordinary fashion.

What is to be done then? We shall not attempt to surmise, but the figures for the growth of traffic in the past, and for the corresponding growth of other city traffic, indicate in a startling way that the day when this question must be asked in earnest is not far off.

It may be gravely questioned whether some such automatically acting buffer as has been suggested, would not be even now an expedient and wise addition to the plant of the bridge. Several more or less serious collisions have already resulted which it would have prevented, and although the danger of further ones is not great, yet there is a danger and ever must be. When a discharging train is ready to be switched away the following train is within 600 ft. of it, disconnected from the cable, and moving at a somewhat higher speed than it. The constant dependence for preventing collisions is on the caution and care of employés, which means that it will certainly fail, and collisions result, from time to time. The rising of the sun is not more certain than this. If such dependence were a necessary evil, it might be borne, for as we say, the risk to each train is very small, but it is not necessary, and such an apparatus as that spoken of would not only do away with *all* risk of collision, but readily enable 50 per cent. more trains to be run at once.

PERSONAL.

WM. K. LYON, of Bridgeport, Conn., has been appointed Superintendent of the Housatonic R.R., to succeed H. A. BISHOP.

A. B. LINDERMAN, President of the Savannah, Dublin & Western Short Line Ry. Co., has resigned and will be succeeded by DOUGLAS GREEN, of New York.

ANDREW D. WILSON, of Denver, Col., has been appointed State Railroad Commissioner for Colorado.

SPENCER SMITH, one of the owners of the Council Bluffs (Ia.) *Nonpariel*, has been appointed State Railroad Commissioner for Iowa.

N. C. RAY has resigned his position with the Union Pacific R. R. at Anaconda, Mont., to accept an appointment as Resident Engineer of the Montana Central R. R., with headquarters at Butte, Mont.

W. L. RICHARDS, Aberdeen, Dak., is Chief Engineer of the Aberdeen, Bismarck & Northwestern R. R., which is the new name of the Ordway, Bismarck & Northwestern R. R.

GEORGE WAGGONER, of Corvallis, Ore., and Senator SLATER have been appointed State Railroad Commissioners for Oregon.

JASON ROGERS has been appointed to succeed W. T. JOHNSON, of Chicago, as State Railroad Commissioner for Illinois. Gen. JOHN I. RINAKER and B. F. MARSH were reappointed.

EDW. BARRINGTON, of Washington, D. C., has been appointed Chief Engineer of the Kansas City, Superior & Northwestern Railway, and the Pacific Railway in Nebraska, and is now actively engaged in superintending the location of same, with headquarters at Superior, Neb.

L. D. BRUYN, Resident Engineer of the New Jersey Southern, and New York & Long Branch railroads, died suddenly, at Red Bank, N. J., on April 11, from heart disease.

Prof. TYNDALL, after a continuous service of 33 years, has resigned as Professor of Natural Philosophy at the Royal Institution. Ill health is the reason given. He delivered his first lecture in 1853, and part of the time was acting in conjunction with FARADAY.

COL. BRADFORD DUNHAM, late General Manager of the B. & O. R. R. has been appointed General Manager of the Capital City Street Railway and the Highland Park Improvement Co., consolidated, of Montgomery, Ala.

JACOB RUBERT, Commissioner of Marion County, Ind., died recently at Acton, Ind., at the age of 67. Mr. RUBERT was a contractor, of Indianapolis, and among other buildings he built the old Union Depot.

THE President has appointed the following Government directors of the Union Pacific R. R. Co.: FREDERICK R. COUDERT, of New York; FRANKLIN MACVEAGH, of Chicago; ALEXANDER HASKELL, of Columbia, S. C.; MARCUS A. HANNA, of Cleveland, O.; and JAMES W. SAVAGE, of Omaha, Neb., all re appointments, their former terms having expired.

EXPANDING CEMENT TO STOP LEAKS IN MINES.—Calcined soda, anhydrous alum, kieserite, or oxychloride of magnesium, mixed into a paste by the process of M. TIETJENS, will swell as it hardens, and is used by him to inject, by a suitably arranged pipe, into rock fissures, to stop flow of water.

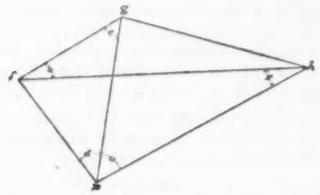
CORRESPONDENCE.

A New Solution of the Three-Point Problem.

LOWELL, Mass., April 4, 1887.

EDITOR ENGINEERING NEWS:

The following is a solution of the three-point problem, which I have recently obtained. A similar solution may have been given before, but if so I have never seen it:



Three points, f, g, and h, are given: it is required to find the position of a fourth point, p, the data being the measured angles a and d, the known distances fg and fh, and the included angle b. We have $b + c = a + x$, or $c = x + a - b$

$$fg = \frac{fp \sin d}{\sin e} = \frac{fp \sin d}{\sin (x + a - b)}$$

$$fh = \frac{fp \sin (a + d)}{\sin x}$$

Dividing the first of these equations by the second, and transposing, we obtain,

$$\frac{\sin x}{\sin (x + a - b)} = \frac{fg \sin (a + d)}{fh \sin d} = c$$

$\sin x = c \sin (x + a - b) = c [\sin x \cos (a - b) + \cos x \sin (a - b)]$ Transposing and factoring with reference to $\sin x$ and $\cos x$. we have, $\sin x [1 - c \cos a - b)] = \cos x \, c \sin (a - b)$. Dividing through by $\cos x [1 - c \cos (a - b)]$ we obtain,

$$\tan x = \frac{c \sin (a - b)}{1 - c \cos (a - b)}$$

The angle x being determined all the other angles and distances are readily obtained.

When $a = b$ the formula does not apply; but in this case the problem is indeterminate.

F. GILMAN.

[We are of opinion that a three-armed protractor "lays way over" this solution for practical work, but as there are always many interested in such mathematical puzzles, we leave it for them to say whether this solution is really new and an improvement or not.—ED. ENG. NEWS.]

Upsetting Bridge Bolts.

TRENTON, N. J., April 6, 1887.

EDITOR ENGINEERING NEWS:

In the proceedings of the American Society of Civil Engineers published in the NEWS of the 2nd. inst., I noticed in a quotation from an article on "Screw Threads," by Mr. JOHN L. GILL, Jr., from the fourth paragraph the following: "it is impossible to heat a rod in a smith fire without the risk of injuring the iron by overheating, and, in upsetting, the fibre of the iron is so distorted as to reduce the strength of the rod very materially."

As I have had much experience in the testing of bridge bolts with enlarged screw ends, and in one instance to the number of between five and six thousands of rods; and as my experience has been the reverse of Mr. GILL'S, I take the liberty of sending you an article upon that subject, published for myself some twenty-five years ago.

On page four, paragraph three reads as follows: "two bars of iron each $1\frac{1}{16}$-in. diameter were successively put into the testing machine, and power applied until they were torn asunder. The bars broke in the *sound or unwelded* part showing a good quality of iron, and the screws remained uninjured, the ends of the bars having been enlarged previous to the cutting of the screws."

I think Mr. JOSHUA HUNT, son-in-law of the late Mr. DAVID THOMAS, was present when the above took place.

If the upsetting had injured the iron the breaks would have taken place in the threads, at the bottom of which the bolts were the same in diameter as the balance of the rods.

Possibly when the upsetting is properly done, and the parts swaged down to the right size, the iron is improved by such a refining process.

Yours truly, F. C. LOWTHORP.

False Skew Arches.

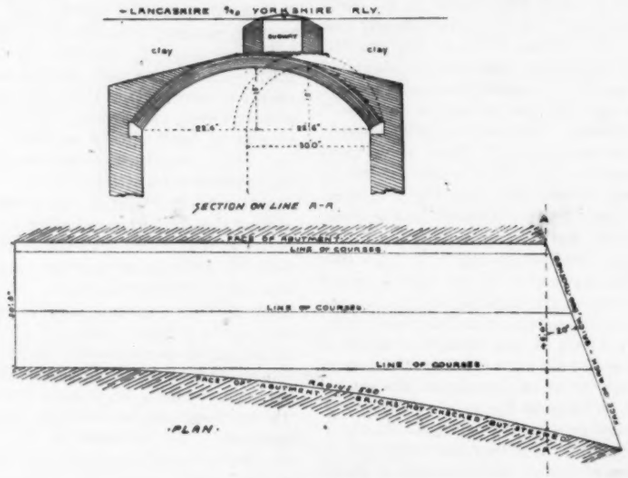
FORT COULONGE, QUEBEC, April 2, 1887.

EDITOR ENGINEERING NEWS.

Although I do not in anyway agree with the principles laid down by your correspondent on the above subject, in your issue of March 26, especially if I understand him correctly, that an arched bridge, as illustrated by him, is as strong as one built on correct principles, say on the logarithmic method, still I can, to a great extent, confirm that arches built as described by him certainly do stand the test of stability. I have built several of these so called unsound arches for under-crossings and for culverts, yet still they remain standing; I however certainly would not like to build one of the dimensions shown by Mr. BRENDLINGER, neither would I approve of their adoption. I enclose you a sketch of an arch on the false skew system built by me about nine years back, under four lines of rails of the Lancashire & Yorkshire Railway at Sandhills near Liverpool, England, for the purpose of allowing the Cheshire Lines Railway access (under the first mentioned railway) to the Mersey Docks. This arch was built throughout of best blue Staffordshire bricks, and if I remember right was eight bricks thick, and had no stone voussoirs, thus showing that it is not absolutely necessary, as stated by Mr. BRENDLINGER, that the end of "the ring stone A" should extend "some distance back of d, not less than a foot." You will notice from the sketch that in addition to one face of the arch being skewed, the abutment wall on one side is circular on plan, and the other face of the arch is at right angles to the abutment; the first difficulty was overcome by checking the skewbacks so as to allow the bricks without being cut to fit square upon them; the other was avoided by the false skew system.

The crown of the arch is also used by the Lancashire & Yorkshire Railway as a subway for passengers to cross from one platform to another.

Your's respectfully, EDWARD A. EVANS.



False Skew Arch.

Locating the Duluth, South Shore & Atlantic.

HURLEY, Wis., April 6, 1887.

EDITOR ENGINEERING NEWS:

The following notes of work in the upper peninsula of Michigan may be of interest. I have run transit on surveys from last November until April 1st., in which time I have not seen the bare ground, and we missed only one day's work in the field.

There were eight locating parties in the field, all of which are now being placed on construction.

Our hardships were many, especially on moving days, when we packed our whole outfit on the backs of men. They would average 100 lbs., eight miles in a day. Several of the parties had a dog team, consisting of three dogs and an 8-ft. toboggan.

These would haul 600 lbs. ten miles in a day, when we had a fair path, or trail, cut through the woods. Our average run with four and five axemen, through heavy pine forests, would be 50 stations, without snow shoes, and 70 stations with snow shoes.

Several times I had my nose and ears frozen; but we never found it too cold to handle the instruments, with gloves, even when the thermometer stood 40° Fahr. below zero.

The spring thaw has not begun, and there is now 3 ft. of snow on the level, all over our line.

We have 200 miles to build this summer, and the contracts were let over one month ago to four contracting firms, *i. e.*, REXFORD Bros. & HODGE, of New York, Sault Ste. Marie Div.; Summit Div. (I do not know who has it); Gogebic Div., HARRISON & GREEN, Milwaukee; and Western Div. HENRY & BALCH, Minneapolis. Mr. J. A. LATCHA, who was Chief Engineer of the Nickel Plate for this same syndicate (Brown, Howard & Co.) is our Chief Engineer and Superintendent; JOHN F. STEVENS, of Minneapolis is Principal Assistant Engineer. Mr. STEVENS located the heaviest part of the Canada Pacific in the Rocky mountains. There are four Division Engineers, and each contractor has the work of one division. Residencies are 12 miles; I have one of the heaviest.

This road will cost about $30,000 per mile to build. There is little rock work or masonry. Material mostly sand and gravel excepting in the cedar and tamarack swamps; bridges are nearly all 80 ft. Howe truss and piles.

At present the snow being too deep to build grade work, the forces are hard at work clearing right of way.

In several weeks the whole line will have laborers at work on the grade, and the first ten miles will be completed by the latter part of June. It is expected to have trains running before snow falls again.

The Minneapolis, Sault Ste. Marie & Atlantic Railway will also build through this upper peninsula to Sault St. Marie, this summer.

Laborers are more independent, and get as good wages, if not better, in this country than any other part I know of.

There are, near our line, 35 active iron mines along the Gogebic iron range, opened in the last three years, the stocks of which are quoted in Milwaukee, Chicago and Cleveland. Yours truly, D. McC.

Volapuk and Trautwine's Pocket-Book.

EDITOR ENGINEERING NEWS:—

PHILADELPHIA, April 9, 1887.

In your issue of this date, after commenting on the BALDWIN Locomotive Works' designations of their engines (8—30—*C* etc.) as a sample of the proposed universal or Volapük language, you say "The only other use of this branch of Volapük that we know of is on pages 808-9 of TRAUTWINE'S *Pocket-Book*, where it is given *without an accompanying dictionary* (your italics) making it a trifle blind and more than a trifle absurd."

This is hardly accurate. On page 805 we begin the article on Locomotives with "The following list of the dimensions, weights, etc., of some of the principal sizes of locomotives made by the BALDWIN Locomotive Works," as giving "an idea of the present usual proportions of locomotives and tenders as made in the United States"—and immediately give the very necessary "dictionary" in the following words:

"In the designation of the *class* the first number (8, 10 etc.) is the total number of wheels of the locomotive. The second (20, 26 etc.) is an *arbitrary* number indicating the diameter of the cylinders. The *letter* (*C*, *D*, or *E*) indicates the number (4, 6, or 8, respectively) of *driving*-wheels." The table gives the diameters of the cylinders in "United States" as well as in "Volapük," and thus shows in itself, the values assigned to the arbitrary middle term of the symbol.

We also give, on the same page, a dictionary of *our own* Volapük (the use of which was rendered necessary by limited space) as follows: "Under *service*, *P* means *passenger*; *F*, *freight*; *M*, *mixed*; *S*, *Switching*."

The table, thus introduced, fills pages 805 and 806. A list of very large locomotives and remarks on tires, etc., occupy page 807, and on page 808 we give the table of performances of BALDWIN engines containing the "Volapük" symbols; but this table is introduced as applying to "the above described BALDWIN engines," and it was thought that this might induce the curious reader to refer to the "above description" where he would find the needed "dictionary." As to the remarks on page 809 it might be reasonable to assume that the reader had, before reaching that point, acquired some proficiency in Volapük, or at least knew where to find the dictionary; but I hold that a reader should "not be compelled to look back over a number of pages to find the meaning of arbitrary symbols, and to tax his mind with remembering them when found." (Preface to 22nd thousand, page xvi). I accordingly recognize the pertinence of your criticism, notwithstanding its slight inaccuracy, and proceed to profit by it by adding an extra "dictionary" at foot of page 809.

Thanking you for the suggestion. I remain,

Yours truly, JOHN C. TRAUTWINE, JR.

[WE cannot admit that we were even guilty of a "slight" inaccuracy. We stated "without an *accompanying* dictionary" and purposely referred only to the tables on p. 808-9, as they had none. It cannot be expected that users of tables in a pocket-book shall hunt through all its preceding pages to find a dictionary which is not referred to. What our correspondent refers to as his own Volapük (*P* for passenger, *F* for freight, etc.), is not such, but legitimate abbreviation which hardly needs a dictionary. The others are of quite a different category, and instead of carrying out the purpose which he expresses in his last sentence, our correspondent will do well to strike out the obscure designations altogether; explain what kind of engines Am.,T.—W., Mog. and Cons., etc., are and substitute natural designations.—ED. ENG. NEWS].

How to Proceed to Design Iron Floors.

JERSEY CITY, April 11, 1887.

EDITOR ENGINEERING NEWS:

In designing a factory floor the law requires a weight of 250 lbs. per sq. ft. to be allowed for. What is the proper way to proceed to design the floor, or to get the proper size of the girders, and the size and spacing of the iron floor beams (I-beams), from this given weight? A READER.

[The proper way to proceed, if the factory is in Jersey City is, *via* any one of the North River ferries, to the office of any one of a number of civil engineers below Chambers street, New York.. He will design the floor properly, so that it will both be economical *and* stand up under its load. Otherwise, there is danger that neither end will be fulfilled. As the above letter reaches us anonymously we could not ordinarily take notice of it, but in the interest of science and human life give this much advice free.—ED. ENG. NEWS.]

Relics in the old Market St. Bridge, Philadelphia.

PHILADELPHIA, PA., April 6, 1887.

EDITOR ENGINEERING NEWS:

I send you the following, thinking that you may feel an interest in it, and consider it worthy of publication:

In tearing down the old east river pier, of the Market Street Bridge, in the center of it, at low water mark, I discovered a stone about 3 ft. square, on which was cut the date "1801." In this stone was set a plate, on which was the following inscription, in neat script.:

IN THE YEAR 1801

119 years after the founding of the City of Philadelphia and in the 25th year after the separation of America from the Government of Great Britain. This Pier was built under the direction of

R. Peters.	*S. Wheeler,*	*C. Biddle.*
J. Dunlap.	*J. Lownes.*	*E. Hazard.*
G. Fox.	*R. H. Morris.*	*J. Dorsey.*
J. Perot.	*W. Sheaff.*	*W. Poyntell.*
W. Bingham.	*T. Savery.*	

Architect: W. Weston

Master Workmen.

S. Robinson, M. Delaney, T. Vickers.

In the hole that this plate enclosed I found a number of old pennies, and a medal, on the face of which was the bust of GEO. WASHINGTON, and the inscription:

"GEO. WASHINGTON, born Virginia Feby 11, 1732," on the reverse side—"General of the American Armies, 1775; Resigned 1783; President of the United States 1789."

Then at the bottom of the medal in small letters, is a name, (possibly the maker) which looks like Manly & Co., 1790.

Hoping that this may be of interest to you I remain. Yours Very Resp'y.

F. J. AMWEG.

[In ENGINEERING NEWS, Oct. 25, 1884, will be found the inscriptions on the monument erected to commemorate the completion of this bridge, and also what was reported by the local gossips as the inscriptions on the cornerstone of the Eastern abutment.—ED. ENG NEWS.]

PUBLICATIONS RECEIVED.

Technical Education in Industrial Pursuits, with Special Reference to Railroad Service. Report to the President of the Baltimore & Ohio Railroad Co., by Dr. W. T. BARNARD, Assistant to the President. Pamphlet; pp. 168 and 70.

This earnest plea for broader technical education and careful summary of what has been done elsewhere and might be done here deserves a fuller notice than would be appropriate in this column, which we hope to give later.

Third Biennial Report of the State Engineer of Colorado for 1885-86.

Contains detailed reports by the Commissioners of the various water districts; data for the duty of water, condition of the irrigation systems of the State and suggestions and recommendations by State Engineer E. S. NETTLETON.

Annual Report of the Secretary of the Navy, Washington, D. C., pp. 438. Many plates.

Contains a good deal in reference to dry-docks, hydrographic charts, and ordnance.

Second Annual Report of the Board of Railroad Commissioners of the Territory of Dakota. For the year ending June 30, 1886.

Before Dakota is a State it has 2,898 miles of road operated by 9 different companies, an increase of 231 miles, which will be much larger this year. The earnings run up to the very respectable average of $4,103 per mile. The report is accompanied by a full index, and is otherwise a very creditable one.

Institution of Civil Engineers. "Irrigation in Lower Egypt," by WM. WILLCOCKS, with discussion; "Harbor Works in Algoa Bay, Cape Colony," by WM. SHIELD; this is an interesting case of jetty construction. "Central Station Electric Lighting," by KILLINGWORTH W. HEDGES. "On Utilizing Waste Air in Filter-pressing, with some results of pressing Sewage-sludge at Cheswick," by JOS. HEVERINGTON. "Friction Clutches," by WALTER BAYSHAW. "The Iron Skeleton of the Statue of Liberty, on Bedloe's Island, New York Harbor," by THEOPHILUS SEYRIG; this is simply a description of the work done, without any discussion of merits. "Siphon Outlet for a Low Sewer District: Norfolk, Va.," by GEO. E. WARING, JR. "Disposal of Sewage-sludge, and Filter-presses for the treatment of Sewage-sludge," by WM. JOS. DIBDIN and WM. SANTO CRIMP; these are very elaborate, illustrated and lengthy papers, entering very fully into this interesting subject. The discussion by eminent authority is likewise valuable.

Celebrities of the Century, being a Dictionary of Men and Women of the Nineteenth Century. Edited by LLOYD C. SANDERS, pp. 1,077. Cassell & Co. London, New York, etc.

The easiest thing in the world to do with almost any encyclopedia work of this kind is to find extraordinary omissions in it, and some of the omissions in this work are certainly very extraordinary, especially among Americans, where the line as to what made a man a "celebrity" was evidently much more strictly drawn. A great many insignificant English names are here embalmed, and not a few Americans whom one wonders to find in it, but such men as James B. Eads, Eli Whitney, R. B. Hayes, and others, not to speak of Goodyear, Elias Howe, Latrobe, Whipple, Whistler, *pere*, Horatio Allen, McCormick and many others do not appear. But it is a very handy work of reference and seems in the main impartial, accurate and fairly complete. A strange omission is Profirio Diaz, the present president of Mexico, and the allegation that Maximilian had a "mock-trial" is wholly unwarranted. As is to be expected in English works, the credit of inventing and introducing the telegraph is given to WHEATSTONE, but with less injustice to Prof. MORSE'S unquestionable priority in a practical sense than is often met.

A Strange Collision.

Owing to unavoidable limitations of time and space, the illustrated article in our issue of last week, under the above head, was shorn of one of its greatest attractions, the following poem, on which we had chiefly relied to give the detailed facts of the disaster, so that without it, even the time and place of the accident did not appear. The poem is so true to facts that it gives a better report of the details than the newspapers themselves, which did not even give the length of the train; and it is withal so instinct with poetic feeling and true lyric fire, that we were sure our readers would rather hear the story in that way than in our own dull words. Unfortunately they did not get either.

A POEM ON THE LATE COLLISION AT INGERSOLL, ONT., MARCH 20, 1887.

Composed by Joseph Fenton Johnson, late of Hamilton, Ont., and Copied from Original, March 25, 1887.

Approaching noon on Sunday, there was behind its time,
A train known as a (Limited) along the Grand Trunk Line;
Five cars (including Baggage) composed this speedy train,
Being an hour behind its time, it would those moments gain.

But Ingersoll could not be passed—an Express it had to meet;
As the latter had not as yet left its (Dorchester) retreat:
So to a siding it was switched, while the other line was clear,
And to a casual onlooker—one had not much to fear.

Now 732 came up like a "spectral vision,"
When lo! The brakes refused to act—there was a sad collision;
The switchman (as if by inspiration) turned it from the main,
'Twas then the (Limited Express) leaped on to the other train.

No. 177 (a freight) was steering towards the East,
When 732 dashed in like a furious beast,
And rising like a pinnacle, it mounted the other steed,
So by this sudden act at once lessened its frightful speed.

An artist (J. L. Brouse by name) came promptly to the scene,
He photographed the iron horses in a style that was serene.
"Now," if any wish a copy, just to his Studio stroll,
You'll find his place of business in the town of Ingersoll.

Conductor Turnbull at his post, and the most serious hurt,
Saw well the cause, he quickly jumped, and fell near a culvert;
With blackened eye and cheek much torn, was ready to assist,
Nor did he try to shirk his task, or his duty to resist.

The driver and the fireman leaped from their train at risk,
"Death" would have been inevitable had they offered to desist;
As the cab and its approaches were pretty well stove in,
So prudence conquered duty to make their leap no sin.

In all there seemed a "miracle" that no lives were lost,
As two locomotives with nine box cars were smashed at a fearful cost;
A concussion so severe—"one wonders the affair"
Did not cost one single life, as you are well aware.

Almost all of Ingersoll turned out in the afternoon,
As such a smash was seldom known around our little town;
But the best impression most could have—"no lives were sacrificed,
Though the motive power was at once smashed up that was so highly prized.

TECHNICAL NOTES.

The Engineer in reporting the trial of the twin-screw torpedo boat built for the Italian Government by Messrs. YARROW & Co., of Poplar, England, states that the recorded speed was 25 knots, or 28 *miles per hour*. This boat is 140 ft. long on water line; extreme beam 14 ft.; draft, 5 ft. 4 in.; displacement, 100 tons. Steam is supplied by two locomotive boilers and the screws were driven by two pairs of compound engines of "over 1400 H. P. combined." The trial trip took place in the Lower Hope, below Gravesend; "weather very rough," equipment complete and 33 persons and 12 tons of load on board.

THE *Semaine des Constructeurs* again calls attention to the prevention of oscillation in tall structures by superimposed weights. It cites a successful experiment in which a brick chimney 60 ft. high swayed in the wind to a dangerous extent; this was reduced to very inconsiderable proportions by loading the top with a cast-iron crown weighing only 286 lbs. This cap has now for 16 years eliminated all swaying. The same idea has been successfully employed at Müleford during the lifting of a factory with the machinery in motion. This machinery caused troublesome vibrations which were checked by loading the walls with railroad iron during the raising process.

The average daily progress in tunneling, showing the individual and general advance in the character of the drills used, and experience gained, is given as follows by Prof. LORENZ, of Brunn:—

Mont Cenis	first year,	1861,	1.6 ft.—	last year,	1870,	14.8 ft.
St. Gotthard	"	"	1873,	12.1 ft.—	"	"	1877, 19.7 ft.
Ariberg	"	"	1881,	21.4 ft.—	"	"	1883, 36.4 ft.

IT is reported that a depth of over 5200 ft. has been reached in boring at Schladerbach, near Halle, by some Prussian mining engineers.

TO protect the proposed 1000 ft. tower in Paris from lightning, M. EIFFEL is using the following precautions:—At the foot of each of the four foundations are two iron pipes, each about 33 in. in diameter, leading to water-bearing strata beneath the tower. These pipes will be connected with the metal skeleton of the tower by copper fastenings with frequently verified contact points. His plan has been approved by M. M. BECQUEREL and MASCART, Members of the Institute.

THE use of sugar as a strengthening ingredient in mortar has been attracting considerable attention of late in England and America, and we have had long communications regarding its original use in India. But while the compound very probably took its origin in India it would seem that it was really not new in America. In the *Journal du Genie civil, des Sciences et des Arts*, for Dec. 1, 1828, we find under the head of "General Remarks upon Mortars," the following sentence as translated:—"Americans have assured M. DE LA FAYE that they have used with great success a certain quantity of *molasses* mixed with the mortar prepared for aqueducts and reservoirs." We here have a saccharine ingredient analagous to the raw brown sugar, the use of which in India has so recently attracted attention; and yet its virtues were recognized in America 60 years ago.

THE system of steam heating the Pennsylvania Railroad is now testing, designed by Mr. A. S. VOGT, of its mechanical staff, passes the live steam from the boiler through a reducing valve, as usual, which permits only 15 lbs. pressure. The connections from the engine to the cars consist of flexible rubber tubes, strengthened with steel rings and fitted with substantial couplings. The radiators in the cars are laid lengthwise on the floor, close to the side of the car, and passing under the seats. The steam, as it condenses, is got rid of by means of drip cocks (probably steam traps) beneath the cars. The engineers state that the apparatus makes no appreciable difference in the working of the locomotive,—but it takes about half an hour to warm the cars up comfortably, indicating the necessity of having special steam-heating apparatus at the terminal stations.

Steel for Guns.

Col. EARDLEY MAITLAND, R. A., read on March 15 before the Institution of Civil Engineers a paper on "The Treatment of Gun-Steel." The author is the Superintendent of the Royal Gun Factory at Woolwick.

He said that English gun-steel, like that of France and Germany, was a ductile material, breaking under test at 30 tons per sq. in. under tensile strain in the soft or annealed state and at about 45 tons when hardened by being plunged at a temperature of 1450° Fahr. into a bath of cold oil. It contained from 0·25 to 0.5 per cent. of carbon, and from 0.8 to 0.05 of manganese. Col. MAITLAND described the successive steps by which he sought to estimate the value of oil-hardening. From a comparison of thousands of results he believed that, taking the breaking strain after oil-hardening as the datum, that the limit of elasticity in the unhardened state rose with the proportion of manganese; and that the effect of oil-hardening rose with the pro portion of carbon, raising both the elastic limit and the breaking strain more than in the case of steel with a higher proportion of manganese.

The condition of strain, however, in the test-pieces differs from that when built up and used as a gun. This is due to the difference between repeated applications of slowly applied motion and the effect of a falling weight or blow; he showed that there was a certain resemblance between the action of suitable powder and the pressure in the machine.

It had been noticed that in case of bursting the fracture, whether the gun were of cast-iron, wrought-iron or steel, was invariably short and granular. To test the assumption that the slow pull of a testing machine did not fairly represent the sudden strain put on gun material, Col. MAITLAND had test specimens screwed into blocks so arranged that in falling, the upper block was arrested and the specimen subjected to a sudden tensile strain from the weight of the lower block. The result of several experiments showed that instead of the expected elongation of 27 per cent., an elongation of about 47 per cent. was obtained. The author then tried the effect of explosives; a strong tube was prepared by being accurately bored and furnished in the middle with a radial vent and a radial crusher gauge. Plugs of steel fitting the tube were screwed into each end of the specimen; these plugs were passed into the tube and the annular space about the specimen was filled in some cases with quick-burning powder, and in others with gun-cotton, air-spaced. On explosion the plugs were driven out, each carrying half the specimen; the elongation varied from 47 to 62 per cent., and the fracture in all cases was silky and fibrous. Various forms of test-pieces were tried, and the author was convinced that the remarkable shortness of fracture noted in burst guns was a false indication of the quality of the metal.

Col. MAITLAND then proceeded to describe the treatment of the ingot before forging and the method of making hoops and tubes. He thought thorough forging was required to insure the best resistance against erosion, and that it was necessary to put three units of forging work into the metal, taking the unit of work as that done in doubling or halving the length of a forging; a fibrous condition was thus induced. Further, it appeared possible that this fibrous condition was best induced in a gun steel breaking at 40 tons per sq. in. in the specimen and oil-hardended at 1450° Fahr.; although it "mattered little whether the steel were high, medium or low, compared with the great difference due to much or to little forging."

After describing the tubing of guns the author gave in detail a long series of experiments made with the view of determining the tensile strength of specimens cut from in ingot hardened in oil, unhardened and cut with and across the grain. He judged that there was a decided benefit in oil-hardening and annealing, even though the annealing undid the hardening. While all nations making great guns use the oil-hardening process, Col. MAITLAND thought that in large forgings this process was "far less active and far less uniform than in test-pieces;" and it became a serious question whether the double process of hardening and annealing acted so beneficially in the steel as to compensate for the risks incurred in setting up internal strain, this latter being the gun-makers worst enemy. The author thought the formulas used at the Gun Factory for shrinking were thoroughly practical and trustworthy. They are based on investigations by LAMÉ and by RANKINE and were sensibly identical with the rules and formulas published by VIRGILE in 1874.

James Buchanan Eads.

(With Portrait.)

The late death of Mr. EADS at Nassau, N. P. on March 8, 1887, has removed one whose name will be forever associated with the engineering history of our country; a man who was not only remarkable for the conception, and successful completion of very important public works, but for the courage and energy shown in carrying out these works, and a personality that made every one about him share his own enthusiasm, and thus wrest success from conditions that to others would have only meant disaster. Lacking both the education and direct technical training of an engineer, he yet made for himself a name that any engineer might envy, solely by the exercise of that genius, good judgment in the selection of assistants, persistence and courage with which nature endowed him.

Mr. EADS was born in Lawrenceburg, Ind., on May 23, 1820, but at the age of thirteen removed to St. Louis with his parents. From this time forward he was the architect of his own fortune; first selling apples on the streets, then filling an humble position in a store, we find him in 1839 as clerk on a Mississippi steamboat. He had always shown a taste for mechanical pursuits, and increased his knowledge of all pertaining thereto at every opportunity both by study and practice, and his Mississippi experience was the first step in a direction that was to lead him to fame.

In 1842 he constructed a diving-bell—said to have been made of a whiskey-barrel—for the recovery of the cargoes of sunken steamers; and his device was so successful that a company was organized, a better boat provided and equipped with powerful pumps and less crude apparatus, and a business secured that extended the length of the Mississippi river. In 1845, Mr. EADS sold out his interest in this company, and established in St. Louis the first manufactory of glass-ware west of the Mississippi river; but this venture was disastrous, and two years later he found himself burdened with debt to the extent of $27,000.

He again returned to the work of raising sunken steamers, removing obstructions from the river channel and the improvement of the St. Louis harbor. The great fire of 1849 burned 29 steamers at the wharves of the latter city, and Mr. EADS borrowed $1,500 from his creditors to commence work upon these wrecks. Ten years later he had increased this capital to nearly half a million dollars.

His practice had made him familiar with every reach in the Mississippi and its tributaries, and in 1856 he made a formal proposition to the Government to keep the channels of these rivers free of all obstructions for a term of years. The House passed the bill but it failed in the Senate.

From 1857 to 1861 ill-health had forced his retirement from active business, but the events of the last named year called upon him to put at the service of the Government his thorough knowledge of our Western rivers. Called to Washington by Attorney General BATES, he consulted with the President and his Cabinet as to the type of gun-boat and iron-clad best adapted to service on these rivers, and was shortly afterwards appointed, with the late Rear Admiral JNO. RODGERS, to carry these recommendations into effect and to at once improvise three war-ships for use at Cairo. These three boats the Conestoga, Tyler and Lexington, were the first of a mighty fleet and three of the best fighting boats ever in that service. Soon after, seven ironclads were designed by Mr. EADS, and he undertook to build them in 65 days. And notwithstanding the novelty of the work, disorganization of labor and difficulties of obtaining material, he fulfilled the contract, and in 100 days provided eight iron-plated ships aggregating 5,000 tons, armed with 107 heavy guns and fully equipped. In 1862, he built six turreted armored vessels, and to these again were added many lighter gunboats. The Winnebago Monitor, designed by Mr. EADS on the Ericsson system, was the first war-ship ever built in which the guns were handled entirely by steam power.

From 1867 to 1874 Mr. EADS was engaged in the erection of the St. Louis bridge. The problems to be solved in this structure were many and difficult, but the world long ago knows how they were successfully overcome; it is sufficient to say that he founded piers on the bed rock 136 ft. below high water-mark through the shifting sand and mud of the Mississippi, and used steel arches of the then unprecedented spans of 520 and 502 ft., using compressed air in sinking his foundations on a scale never before attempted, and erecting his great arches without false-works, substituting therefor an ingenious system of temporary suspension members from towers on the piers.

The deepening of the South Pass entrance to the Mississippi river will always stand as Mr. EADS' one great work, and had he done nothing else as an engineer this alone would have been sufficient to have earned for him the gratitude of the American people. Commencing in 1874, his views upon the manner of conducting this work were diametrically opposed to the plans of the great majority of the Government engineers, and it was only by demonstrating his faith in his own suggestions by offering to wait for his pay until success was assured that he made any progress. It was difficult to obtain even the permission to make this experimental test, but a bill was finally passed allowing him to commence operations on the smallest of the three river mouths and not the one he had selected. The original depth on the bar was only 8 ft., and this was to be deepened ultimately to 30 ft. at a cost of $5,250,000. The terms of his contract were very stringent; only $500,000 was to be paid after a channel 20 ft. deep by 200 ft. wide had been secured; another $500,000 for a channel 22 ft., deep, and further sums for 26 and 28 ft. depths. But as a guarantee that the maintenance of this channel should not exceed in cost $100,000 per annum, the final million of the total sum was to be retained until a channel 30 ft. deep had been secured throughout 20 years. Congress however voted to pay him $1,750,000 on his obtaining a 22 ft. channel.

His application of the jetty system at this point is too well known to require extended notice here, and in four years from the commencement of active work, the Government engineer officer in charge reported a depth of 30 ft. throughout the channel and the least width of same channel as 200 ft.; the balance due Mr. EADS was then paid him and the one million retained, was considered as earned, and the interest placed to his credit.

Mr. EADS' next and important service was, as a member of the Mississippi River Commission, and during the several years that he was connected with this body some millions of dollars were expended in practically carrying out his views on the jetty system, as previously expressed by Mr. EADS in various publications, and particularly in his review of Humphreys and Abbott's "Report on the Physics and Hydraulics of the Mississippi River."

His last work, and the one which his death left in its initiative stage, was bolder yet in its conception than any of his previous works; it was nothing less than a well-worked out proposition to lift vessels of 5,000 tons burden bodily out of the water, and transport them by a ship-railway across the Isthmus of Tehuantepec. Concessions had been obtained, and all the details of this colossal scheme carefully worked out, and their approval secured from some of the most eminent naval authorities in the world. Mr. EADS has for some years been bravely battling the prejudice of ship masters, and the political opposition of rival schemes for passing from ocean to ocean; had he lived he would doubtless in some manner have demonstrated to the world his ancient and abiding faith in his own plans, and in all human probability again have made the enterprise a success; but his death has ended all that, and whether he has left among his associates one with faith and power sufficient to reach the point of actual test is yet to be demonstrated.

Mr. EADS was a Member of the American Society of Civil Engineers, from Dec. 16, 1868, and Vice-President of that body in 1882-83. He was also President of the St. Louis Academy of Science for two terms, and received the Albert Medal of the British Society of Arts, in recognition of his services to the engineering profession, he being the first American upon whom this honor was conferred.

The Weather of the United States for the Month of March, 1887.

[As respects the elements of most interest to engineers.]

According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	TEMPERATURE. Degrees Fah.				WIND VELOCITY. Miles per hour.			PRECIPITATION. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Heaviest in 24 hours.	No. rainy days.
NORTHERN CITIES.										
Northfield, Vt.	21.1	45.2	−15.0	60.2	13.0	39	N	4.68	1.32	18
Portland, Me.	28.8	46.4	0.5	45.9	9.9	36	SW	4.15	1.19	13
New York City.	34.3	49.6	16.3	33.3	11.0	34	NW	3.51	1.40	10
Pittsburg, Pa.	36.8	68.5	14.9	53.6	8.2	34	W	1.49	0.28	17
Chicago, Ill.	31.9	64.0	5.3	58.7	11.1	35	N	0.89	0.48	6
Omaha, Neb.	38.0	78.1	10.2	67.9	7.4	40	NW	0.48	0.40	5
St. Paul, Minn.	26.9	53.6	−7.1	60.7	6.6	28	W & NW	0.33	0.19	4
Duluth, Minn.	21.1	52.8	−13.0	65.8	5.7	29	NE	0.55	0.42	4
Bismarck, Dak.	24.9	54.0	−15.7	69.7	8.4	44	NW	0.78	0.58	6
Average.	29.3	57.4	7.0.0	57.3	90.3	35.4		1.87	0.70	9.2
SOUTHERN CITIES.										
Washington City.	38.5	65.0	20.8	44.2	8.5	27	NW	3.83	1.54	14
Louisville, Ky.	45.3	79.3	18.0	61.3	8.3	43	SW	1.88	1.23	12
St. Louis, Mo.	45.8	79.1	22.9	56.2	9.6	38	W	3.54	1.79	9
Savannah, Ga.	56.5	81.2	32.5	48.7	8.3	25	NW	0.76	0.36	7
Leavenworth, Kan.	42.7	83.6	20.5	63.1	8.0	28	NW	1.59	0.80	8
Jacksonville, Fla.	59.5	80.0	35.7	44.3	3.7	24	W & NW	3.51	2.04	4
Chattanooga, Tenn.	50.8	76.1	25.2	50.9	7.7	28	NW & SW	4.32	2.20	9
New Orleans, La.	62.1	80.8	43.8	37.0	7.6	23	N	3.37	1.55	7
Memphis, Tenn.	53.7	76.8	30.2	46.6	7.2	31	NW	4.18	2.82	7
Palestine, Tex.	61.5	85.1	33.9	51.2	10.4	36	S	1.45	1.27	4
Average.	51.6	78.7	28.3	50.4	7.91	30.4		2.85	1.56	8.0
FAR WESTERN CITIES.										
Helena, Mont.	40.3	67.4	4.2	63.2	9.6	36	SW	0.12	0.04	5
Port Angeles, W. T.	40.7	53.3	23.7	29.6	4.7	29	W	3.65	1.32	18
San Francisco, Cal.	54.3	78.0	45.0	33.0	7.9	28	W	0.84	0.52	4
Salt Lake City, U.	47.1	73.9	27.5	46.4	5.3	27	NW	0.35	0.13	7
Denver, Col.	45.9	74.7	13.2	61.5	8.1	44	W	0.23	0.08	4
Yuma, Ariz.	69.9	92.2	42.6	49.6	6.2	28	N	0.00	0.00	0
Santa Fé, N. M.	43.0	67.0	19.5	47.5	3.8	15	E	0.56	0.32	4
Average.	48.7	72.4	25.1	47.2	6.51	29.6		0.84	0.33	6.0

SOCIETY PROCEEDINGS.

Engineers' Club of Kansas City.—At the regular meeting of the Club held April 4 in the Club Room, the following were proposed as members:—R. C. PEARSONS, W. K. BOWEN, JOHN F. WALLACE, T. F. WYNNE, W. NORRIS, E. W. GRANT.

A paper was read by WM. D. JENKINS, C. E., engineer in charge of the Randolph Bridge, on "Compressed Air as Applied to the Construction of Foundations." The paper was fully illustrated by drawings and photographs of the Randolph Bridge Caisson and Foundations, and was discussed by those present. Among other things he said that the foundations were to be carried to a depth of 125 ft., spans to be 650 ft. in the clear, height above water 50 ft., and the structure proportioned to carry in addition to the dead load a live load of 80 tons. The caisson roof was capable of carrying 10,000,000 lbs. made of eight courses of 12 x 12 in. timbers.

The Engineers' Club of St. Louis met April 7, and more than thirty members were present. In the absence of Prof. POTTER, Vice-President HOLMAN took the chair and WM. H. BRYAN acted as secretary. Engineer BENT RUSSELL of the city water works read a carefully-prepared and very interesting paper on "Drainage and Filling Water Mains." Prof. C. M. WOODWARD discussed the recent fall of the Bussey Bridge on the Boston and Providence railroad. He illustrated different sections of the bridge on the blackboard and analyzed them from an official standpoint, showing very clearly the faulty design of the work. He said that the only wonder was that the bridge held out as long as it did.

The discussion afterwards became general, Prof. JOHNSON, Vice-President HOLMAN and others calling attention to other weak points of the structure.

In conclusion, Prof. JOHNSON referred to the meeting of engineers in Chicago next week, and expressed a desire to have St. Louis well represented there. He hoped that a fraternal feeling between the brotherhood would be encouraged.

THE market gardners in the neighborhood of Sewickley, Penna., are reported to be experimenting with natural gas as an adjunct in raising early spring vegetables; the heat thereof being substituted for the usual hot house.

A LOCOMOTIVE burning gas made from petroleum was tested in Meadville, Pa., last week, with apparent success. About 5 gals. per hour were used while switching 12 cars around the yard. Locomotives burning petroleum are in regular use in Russia, but they have so far never been a success in this country, more because there did not seem to be any money in it than from mechanical difficulties. Were all the locomotives in the country to burn petroleum it would far more than exhaust the whole known supply.

MARKET REPORT.

With a production of nearly twenty thousand tons of crude iron per day, and an output of between six and seven thousand tons of steel rails per day, a very marked increase in the production of all kinds of iron and steel productions, as compared with last year, manufacturers of iron and steel are barely able to promptly fill the orders booked during the winter for spring delivery. The iron and steel interests have been exceptionally fortunate, and are now crowded with orders, and have indications that the present activity will continue for months to come.

The strong points are, first, great activity in railway construction; second, bridge construction; third, mill shop, and house construction; fourth, expansion of manufacturing capacity in the shape of machinery, engines, tool equipments and appliances, of every variety.

The leading manufacturers of engines, report themselves further oversold than ever before. The rail makers have contracts that, according to latest estimates, will keep them busy far into the fall. The annual rail-making capacity of the country is estimated at 300,000 to 400,000 tons. The gross producing capacity has been put at 2,000,000 tons. The inquiries now in the market will cover the entire unsold capacity.

There are a multitude of railroad building enterprises in hand, for which supplies have not yet been purchased. Brokers have been conducting negotiations with foreign rail makers for supplies of rails to be delivered in the west and south, and on the Pacific coast, there is at this time inquiries for no less than 100,000 tons of material, of various kinds for shipment here during the summer and fall. This exceptional activity has stimulated home manufacturers to an extension of their capacity, and a ready plans are under consideration for the enlargement of some of our Bessemer mills, and new ones have been projected.

The locomotive builders are very busy, and in some few cases are working over time. Railroad managers are ordering locomotive capacity for future requirements, with much more confidence than they have done.

Car builders throughout New York, Pennsylvania and the west, have assurances that their shop capacity will be fully employed throughout the summer, and even with the great increase of rolling stock, that has been brought about within the past six months, complaints are still made by shippers and railroad men of a scarcity of cars.

Facts like these strengthen the conviction that the industrial activity is not of a temporary sort, but that it will continue throughout the year.

The multiplication of industrial enterprises and investments continue to attest the confidence of manufacturers and investors in the permanency of the healthy activity in all directions.

Prices are steady in iron, steel, lumber, coal, petroleum, and in general capacity, railway and building material, and in fact in all the various departments of labor.

Labor is disposed to acquiesce in the present rates, and to continue quietly at work. Here and there an outbreak is threatening the general peace, but the probabilities are that no serious trouble will be apprehended from labor organized or unorganized.

Steel rails are selling at mill at $39 to $40. Merchant bar iron at from two to two and one quarter. Plate two and one quarter to two and one half at mill. Nails $2 50 to $2 60 per keg.

Structural iron from two and one quarter to three and one half, according to shape. Foundry iron at from $19 to $22, according to quality. These prices will in all probability remain steadily throughout the summer. The propability of fluctuating prices is less than for two years, and projectors, manufacturers, builders and all others engaged in the extension of the business of the country are able to rest under the very strong probability that existing values will not be disturbed by visible or unseen causes.

CONSTRUCTION NEWS.

Water.

Granite Wharf.—The following proposals for the construction of a granite wharf at the custom house, Charleston, W. Va., have been received at the office of the Supervising Architect, Treasury Department, Washington, D. C.: Robert McCarrel, $32,699; Orman & Stewart Stone Co., Nashville, Tenn., $34,760.16. The contract was awarded to Robert McCarrell.

The Belle Plaine (Ia.) Geyser is still uncontrolable, according to last accounts. The latest attempt to shut it in, included the sinking of 162 ft. of 16-in. wrought-iron pipe; but the water still comes up outside of this pipe owing to periodical choking with sand and gravel. Stone filling around the pipe sinks out of sight as fast as put in. The discharge from the well comes in regular pulsations, 40 to 50 per minute, and has done so since the first outbreak.

Brookline, Mass.—The Water Board has presented its report for 1886, being the eleventh annual report. During the year 1,932.9 ft. of low service and 6,305.1 ft. of high service pipe were laid and 115 new services put in. There are now 204 hydrants in use, 168 low service and 36 high service; there are also 121 meters. Extensions of the pipe system are recommended. The total consumption was 256,849,645 gals. Tables of the records of the engines at the high and low pumping stations are given. F. F. FORBES is Superintendent.

Richmond, Va.—The Superintendent of the Water Works, C. E. BOLLING, has presented his report for 1886, being his second annual report. During the year 20,-089 ft. of mains have been laid, 3, 4 6, and 20-in. diameter, and 28 hydrants and 52 hydrants put in. There are now in use 38 meters and 429 hydrants. The total consumption was 4,499,163,110 gals. The water is reported to be of good quality, but at times discolored; to remedy this storage reservoirs are recommended. Mr. BOLLING makes some remarks on water waste.

Lake View, Ill.—The annual reports of the town officers for the year 1886, have been presented to the Board of Trustees. During the year 6.7 miles of sewers have been built, exclusive of .75 mile of the Robey street system; over eight miles of water pipe have been laid, 6.275 ft. of water service pipes and 9,660 ft. of gas mains; considerable street improvement work has been done, a new breakwater built at the waterworks and other improvements made. During the present year further improvements will be made, the plans for which are in preparation. The total length of water mains at present is 303,573 ft., of sewers, 123,-068 ft., and of gas mains, 67,548 ft. The total amount of water pumped during the year ending Feb. 28, 1887, was 1,166,451,100 gals., as against 723,863,636 for the previous year. EDWARD RUMMEL, Supervisor; JOHN W. ALVORD, Town Engineer; EMIL TEUBNELL, Superintendent of Public Works.

Pawtucket, R. I.—The Sewer Commissioners have made their report for 1886, being the second annual report. Considerable damage has been caused by freshets and an explosion of naptha gas occurred in the sewers in July. Three flush tanks, 41 catch basins, 30 manholes and 26 lamp holes have been constructed. On the construction of the Division street sewer a Carson trenching machine is being used which excavates and backfills at the same time. The sewerage system comprises the following: Brick; 48-in., 36 x 54, 32 x 48, 26 x 39, 22 x 33, 36, 32, 30, 28 and 22 x 20, 10,413.87 ft.; cement pipe; 20 x 30, 24-in., 1,289.11 ft.; Akron pipe; 18, 15 12, 10 and 8-in., 25,498.44 ft.; total, 37,201.42. Manholes, 178; lamp-holes, 153; catch basins, 162; flush tanks, 17. A. R. SWEET, C. E., is Superintendent of Sewers.

Woburn, Mass.—The Water Commissioners have submitted their report for the year ending Feb. 28, 1887, being the fifteenth annual report. An increased supply is recommended. The reservoir is in good condition, but leaks a little when the depth of water is over 22 ft.; it was cleaned out in June and again in September. During the year 9,824 ft. of 1, 2, 4, 6 and 12-in. pipe were laid and 3,484 ft. taken up, six hydrants and 11 gate valves have been put in. The system now comprises 208,146 ft. of pipe, 294 hydrants, 231 gate valves and 1,773 services; there are also 36 meters, Gem, Worthington, Ball & Fitts, Crown, Union and Desper. The total consumption was 334,419,580 gals., and the daily average has severely tested the supply in the pumping well. PATRICK F. CRILLY is Superintendent.

Proposals Open.

Street Railroad.—Rails, cars, etc. T. R. JONES, Secretary, Dalton Street Ry. Co., Dalton, Ga.

Boring.—For natural gas. J. P. MARION, Secretary, Harrison Natural Gas & Oil Co. Harrison, O.

Railroad and Bridges.—Standard gauge railroad, 140 miles; eight iron bridges. J. D. WILLIAMSON, President, Rome & Carrollton R. R. Co., Rome, Ga.

Excavation.—Prices per cu. yd. for cellars and trenches; 17,000 cu. yds.; for building at Omaha, Neb. W. T. BOOTH, New York Life Insurance Co., 346 Broadway, New York City.

Water Pipe.—Cast-iron pipe, 900 lengths of 6-in, 60 lengths of 8-in., 40 lengths of 16-in.; specifications at office of Chief Engineer; bids per ton of 2,240 pounds. THE BOARD OF PUBLIC WORKS, Jersey City, N.J. April 18.

Jail.—THE MAYOR, Henderson, Tex. April 19.

Sewers.—Vitrified pipe sewer, 8-ins. and 15 ins. diameter, manholes, lampholes, catch-basins, flush tanks, connections, etc. W. J. FLANAGAN, City Clerk, Binghamton, N. Y. April 19.

Paving.—Cedar block and cobblestone roadway. WM. CARLYLE, Chairman of Committee on Works, Toronto, Canada. April 19.

Street Lighting.—Gas and electricity. SIDNEY FARRAR, Chairman of Committee on Lamps, Wells & Pumps, Paterson, N. J. April 20.

Terra Cotta Pipe.—Terra cotta pipe, 12,000 ft. of 8-in., 25,000 ft. of 2-in., 3,000 ft. of 15-in., 5,000 ft. of 24-in.; Y-branches, 600 8-in x 6-in, 4,000 12 x 6, 800 24 x 6; connecting thimbles, 300, WILLIAM LUDLOW, Engineer Commissioner, Washington, D. C. April 20.

Water Supply.—Water-works for the agency buildings, which are situated on the banks of the Missouri river; about 7,000 ft. of iron pipe will be required; the plant is to consist of a Knowles boiler and pump, boiler house, stone reservoir of 1,000 barrels capacity, 1 fire and 10 yard hydrants, 550 ft. of 2-ply rubber hose, galvanized iron pipe and connections; stone and Indian labor can be obtained at the Agency. J. F. KINNEY, U. S. Indian Agent, Yankton Agency, Dak. April 21.

Cement, Lumber and Supplies.—Portland cement, 70 barrels; Rosendale cement, 20 barrels; lime, 50 barrels; lumber, iron, tin, etc. Department of Public Charities & Correction, 66 Third avenue, New York City, April 22.

Sand and Cobble Stone.—For the current year. DEPARTMENT OF CITY WORKS, Municipal Building, Brooklyn, N. Y. April 23.

Grading.—Streets and alleys. J. E. HOUSE, Chairman of Board of Public Works, Omaha, Neb. April 23.

Light House.—Rebuilding light house at end of breakwater in Marquette harbor, Lake Superior. Major S. M. MANSFIELD, U. S. Light House Engineer (10th and 11th Districts), Detroit, Mich. April 23.

Elevators.—Two hydraulic passenger elevators at the U. S. Capitol. EDWARD CLARK, Architect of the Capitol, Washington, D. C. April 23.

Valves.—Seven 30-in. and four 36-in. double disc, geared, screw water-valves, and two 36 in. check valves. All 30-in. and two 36-in. to work horizontally. Check valves and two 36-in. screw valves to have flanged joints. JOHN WHITELAW, Superintendent and Engineer, Office of Water-Works, Cleveland, O. April 23.

Engine Foundations.—Removing old masonry and building foundations for two pumping engines. JOHN WHITELAW, *(as above)*. April 23.

Water Pipe.—Wrought-iron water pipe across Cuyahoga river; 3 ft. diameter, 224 ft., horizontal measurement, between flanges, dip of 26 ft. in crossing river; iron ¼-in. thick, all joints double square riveted. JOHN WHITELAW, *(as above)*. April 23.

Drain Pipes.—Furnishing and laying all drain pipes, Y branches, bends and traps and building manhole. The Commission for the Construction of the Congressional Library Building, 145 East Capitol street, Washington, D. C. April 25.

Building.—Designs for enlarging, improving and heating the State Capitol, and building fire-proof vaults. JOHN S. MARMADUKE, Board of Commissioners, Jefferson City, Mo. April 25.

Street Work.—Taking up and relaying pavements. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. April 25.

Dredging.—In Little Harbor, N. H.; Lubec channel, Me.; Penobscot river, Me.; Narragaugus river, Me. Separate bids. Major JARED A. SMITH, U. S. Engineer Office, Portland, Me. April 30.

Grading and Paving.—Grading, curbing and stone block, hard burned paving brick or block pavement. Specifications at office of R. R. MARBLE, City Engineer. THE CITY CLERK, Columbus, O. May 2.

Pipe, Castings, Etc.—Cast-iron and terra-cotta pipe, castings, etc.; delivered at Willets point, N. Y. H. HENRY C. HODGES, Deputy Quartermaster General, Army Building, corner Houston and Greene streets, New York City. May 2.

Building.—Rebuilding keeper's dwelling at Tchefuncta river light station. Major W. H. HEUER, U. S. Light House Engineer (7th and 8th districts), New Orleans, La. May 2.

Viaduct.—Wrought-iron viaduct with approaches, over railroad tracks. Plans and specifications in the office of the City Engineer. M. J. CLOYES, Chairman of Committee on Improvements, Atchison, Kan. May 2.

Electric Lighting.—J. N. HARDY, Comptroller, New Orleans, La. May 2.

Institution.—Buildings, cottages, water pipes, hydrants, plumbing, gas mains and fitting, heating and ventilating. Architect, H. C. LINDSAY, Zanesville, O. R. B. BROWN, Secretary of Board of Trustees, Ohio Soldiers' & Sailors' Home, Sandusky, O. May 5.

Buoys.—Maintaining buoys in Hudson river, Lake Champlain, Pawtucket river, on south side of Long Island, and in Housatanic river. Commodore A. E. K. BENHAM, U. S. N., U. S. Lighthouse Inspector (3rd District), Tompkinsville, N. Y. May 9.

Dikes and Mattresses.—In Rappahannock river, Va. S. T. ABERT, U. S. Engineer Office, Washington, D. C. May 11.

Water-Works.—Specifications on file. THE CHAIRMAN OF THE BOARD OF PUBLIC IMPROVEMENTS. Fernandina, Fla. June 1.

Contracting.

Water-Works.—R. P. McCormick & Co., of Kansas City, Mo., have been awarded the contract for the construction of the water-works at Hiawatha, Kan., for $50,000.

Moffet, Hodgkins & Clark, of Watertown, N. Y. have been awarded the contract for the construction of the water-works at Goldsboro, N. C. A stand pipe will be built.

Accident on the New Croton Aqueduct.—On April 11, a fatal accident occurred at Shaft No. 10, by the falling of a loaded cage down the shaft, crushing some men at the bottom. Three men were killed instantly. The coroner's jury rendered a verdict censuring Brown, Howard & Co., for not having other than Italians to guard the cage.

Sewers.—At Detroit, Mich., the following contracts have been let for lateral sewers: Thomas Whittaker, 80 cts. per ft.; Louis Lemkie, 73, 73, 77, 79 and 87 cts; Robt. Borchard, 63, 68, 73, 75, 82 cts.——At Central Falls, R. I., Perkins & Woodbury have completed their sewer contract.——At Cambridge, Mass., the City Engineer recommends new sewers, improvements and extensions at an expenditure of $36,500.——At Cleveland, O., two important sanitary measures are contemplated, one is the project to build a large sewer to conduct the entire sewage of the city into the lake; the other is to make Walworth run a sewer.

New War Ships.—Plans were opened April 1, at the Navy Department, Washington, D. C., for an armored cruiser and an armored battle-ship; the hull of each is required to be of steel, double bottomed, with watertight compartments, a ram bow, and steel armored deck covering the machinery; the cruiser will have a battery of four 10-in. and six 6-in. rifles and machine guns; the battle-ship will have a battery of two 12-in. and six 6-in. guns and a secondary battery. Plans were submitted by the following: Barrow Shipbuilding Co., England (two designs); Thames Iron Shipbuilding Co., England, (two designs); Mr. Watt, Birkenhead, England; Bureau of Construction, Navy Department (two designs); A. H. Granjean, France; Capt. M. S. Clayton, New Zealand; Lieut. W. I. Chambers, U. S. N.; Francis L. Norton, Washington; Capt. N. L. Towns, New York; Naval Constructor S. H. Pook.

Underground Wires.—The Edison Electric Illuminating Co. has submitted specifications to the Council, Albany, N. Y., for laying the wires underground. The plans call for iron pipe mains, 4ins. in diameter, which are to contain the wires, to be laid in the principal streets within a short distance from the station. From these mains it is proposed to make distribution by means of flexible cables about 2 ins. in diameter containing three wires, these cables to be laid in shallow wooden boxes filled with tar. The mains and cables are to be laid either under the sidewalks or in the street near the curb line in trenches from 18 to 24 inches wide and from 24 to 30 inches deep. Beyond the central portion of the city it is proposed to carry the wires on poles. The mains and cables are claimed to be practically indestructible.

Cleveland, Akron & Columbus R.R.—Contracts have been awarded as follows for the completion of the Dresden branch: For Section 23, including tunnel with masonry lining, Keating & Co., Pittsburg, Pa., $108,535; all other work to F. M. Ellsworth & Co., Rochester, N. Y., $134,595; there were 93 bidders and the amounts are calculated from approximate quantities at prices of proposal. For iron bridges; Nos. 4, 5 and 6, Penn Bridge Co., Beaver Falls, Pa., $21,660; all other bridges, Smith Bridge, Co., Toledo, O., $43,710; total, $65,310; there were ten bidders and the bridges are to be of iron with iron stringers. JAMES HARRINGTON, Akron, O., is Chief Engineer.

Hodgenville & Elizabethtown R. R.—Bids for the construction of the road have been received by the Kentucky Paving & Contract Co., Louisville, Ky., from Ryan & Coyne, Russellville, Ky.; Hawkins & Tipton, Louisville; Long & Co., Louisville; Lyle & Co., Columbus, Ind.; Dennon & Co., Cleveland, O.; G. Caseman, Cleveland, O., and J.C. Rodemer, Gallatin, Tenn. Prices for earth ranged from 15 to 20 cts. The bridge across the cut-off at Louisville, 145 ft. span, will be completed by June.

The Mount Vernon Bridge Co., of Mount Vernon, O., has increased its capital stock from $40,000 to $100,000.

Water Tower.—The contract for the water tower at Salisbury, N. C., has been awarded to the Sharon Boiler Works, Sharon, Pa.

The Buffalo Granolithic Paving Co. has been incorporated at Buffalo, N. Y., by Robert K. Hefford, Clarence M. Bushnell and others. Capital stock, $10,000.

The Duluth Steam Barge & Railway Supply Co. has been incorporated at Duluth, Minn., with a capital stock of $30,000, to manufacture frogs, switches, axles, shafts, etc.

Bridge Wanted.—C. M. LIDDLE, of Handsboro, Miss., desires estimates for a bridge, with draw, iron or wood, over a stream 360 ft. wide. The cost of lumber to be used in construction not to be considered

The Cross-Tie Lumber Co. has been incorporated at, New Orleans, La., by Edward DeArmas, J. D. Willis, and others, to manufacture cross-ties, bridge timbers, etc. Capital stock, $10,000.

Gas Pipe.—The Gas Trust's Committee on Distribution has awarded the contract for 1,500 lengths of 4-in. pipe to the McNeal Pipe & Foundry Co., Burlington, N. J., at 28 cts. per ft.

Pipes and Castings.—At Pittsburg, Pa., the contract for pipe has been awarded to the Lake Shore Pipe Co., of Cleveland, O., for $32.45; for castings, to Wm. Yagle & Co., Pittsburg, for $54 per ton.

Dredging.—The following proposal for dredging in Redwood Slough was opened March 30 by COL. G. H. MENDELL, U. S. Engineer Office, San Francisco, Cal.; M. J. Madison, 24 cts. per cu. yd.

Pumps.—The Trustees of Lake View, Ill., have awarded the contract for a pump with a daily capacity of 12,000,000 gals. to the Holly Manufacturing Co., of Lockport, N. Y. for $47,500.

Bridges.—At Denver, Col., the following proposals have been received by the Board of County Commissioners for the construction of three wooden bridges of 20 ft. span each, with roadways 16 ft. wide, and on pile foundations: R. Jackson, $855; Thos. O. Brown $960: W. E. Edom, $1,150; A. F. Rafert, $1,881.

The Abendroth & Root Manufacturing Co., of New York, reports sales, through A. S. Fiske, the agent at Cincinnati, O., of two 150-H. P. Root Sectional Safety boilers for the Brush Electric Light Co., at Louisville, Ky., and another of the same size is ordered for the Edison Electric Light Co., Detroit, Mich.

Messrs. A. & F. Brown, manufacturers of pulleys, shafting and hangers, will remove their office on May 1 from 43 to 44 Park Place, New York. The firm will shortly move the principal portion of their works to Elizabeth, N. J., retaining, however, the machine shop of the old established works on Lewis street, New York.

Iron Posts for Electric Wires.—T. WM. HARRIS, contracting engineer, of Boston, Mass., is putting up wrought-iron posts for the Harlem Electric Light Co.: they are 4 ins. in diameter at the bottom and 2¾ ins. at the top. No objection to the posts is made by the property owners. These posts are well adapted for carrying the wires for electric railroads, being small and ornamental.

The Hyatt Filter.—The Newark Filtering Co., of New York City, reports that within the past month Greenwich, Conn.; Owego, N. Y., and Los Angeles, Cal., all of which cities have water more or less turbid, have adopted the Hyatt Pure Water System to purify the water supply. Seventeen cities and towns have now adopted this system and have plants either in operation or in course of construction. Many large manufacturers, using over 1,000,000 gals. of water daily, have also adopted this system.

Road Roller.—The following proposals for a steam road roller were opened April 11 by WM. LUDLOW, Engineer Commissioner, Washington, D. C.: Barber Asphalt Paving Co., New York; (Aveling & Porter engine, 10 tons) $4,300. Pioneer Iron Co.; (10 tons) $4,500; Foundry & Machine Department, Harrisburg Car Manufacturing Co., Harrisburg, Pa.; (10 tons) $4,000; (12 tons) $4,500; (15 tons) $5,000; W. C. Oastler, New York; (Aveling & Porter engine, 10 tons) $4,800; (12 tons) $5,200; (15 tons) $5,800; (20 tons) $6,800.

Bridge Contracts.—Jacob Kauffman, of Lancaster, Pa., has the contract for the Pequea creek bridge at $645.——J. Reed, of Montreal, has been awarded the contract for the masonry of the Sault Ste. Marie bridge for the Canadian Pacific R. R., at $260,000.——H. E. Horton, of Faribault, Minn., has been awarded the contract for the Water street bridge at Eau Claire, Wis., 860 ft. long, with approaches.——The Pacific Bridge Co., of San Francisco, Cal., has the contract for a bridge at Paso Robles, it will have one span of 150 ft. and two of 100 ft. each.——Hoffman & Bates, of Portland, Ore., have the contract for the elevated roadway, at $5,610.78 cts.; it will be 26 ft. wide with two sidewalks 12 ft. wide.——The Mexican National Construction Co. has commenced work on the joint railroad bridge at Laredo, Tex.

The Poetsch Sooy Smith Freezing Co. is now applying its process to the sinking of a shaft through swampy ground for the Chapin Mining Company in the Lake Superior iron region.

Reservoir.—The following proposals for the construction of a reservoir of 5,000,000 gals. capacity for the water-works at Dover, N. J., were opened April 9: Seymour L. Bartholomew, Asbury Park, N. J., $13,186; Rooney & Finnegan, Paterson, N. J., $13,200; Sommers & Russell, Philadelphia, Pa., $13,468; Reilly & Paddock, Newton, Pa., $13,754.63; George Strowhour & Co., Philadelphia, Pa., $14,210; Wm. H. Evans, Philadelphia, Pa., $14,500; Thomas Hayden, New York City, $18,000; F. A. Snow & Co., Providence, R. I., $55,000. ISAAC S. CASSIN, of Philadelphia, is Chief Engineer of the Dover Water Co.

Harbor Work.—The following proposals for harbor work at Duluth, Minn., have been received by Capt. JAMES B. QUINN, U. S. Engineer Office, Duluth, Minn.: Dredging: Williams, Upham & Co., Duluth, 15.5 cts. per cu. yd.; Charles S. Barker, Duluth, 15.9 cts.; Truman & Cooper, Manitowoc, Wis., 17.5 cts.; Green Bay Dredge & Pile Driver Co., Green Bay, Wis., 18 cts.; Morris G. Dodge, Chicago, 19 cts.; Rensler R. Dodge, Fulton, N. Y., 22 cts.; Carkin, Stickney & Cram, East Saginaw, Mich., 26.5 cts. The contract was awarded to Williams, Upham & Co.——Repairs to piers; Chas. S. Barker, Duluth, $7,800; Peter Lambert, Duluth, $10,705.75. The contract was awarded to Chas. S. Barker.——Placing buoys; the contract was awarded to Chas. S. Barker, the only bidder, at $375.

The Otto Gas Engine.—The Deutz Gas Engine Manufacturing Co., of Deutz, Germany, which owns the "Otto" patents in that country and recently attracted attention by the large sizes of Otto engines supplied to water-works and electric light stations, has obtained a decision in its favor in the suit against Moritz Hille, of Dresden, a manufacturer, and several users of infringing engines. The decision establishes the infringement by the defendants and orders them to discontinue the manufacture and use of the machines; also to account for damages. The Hille engine used the well-known Otto four-stroke cycle, and against its use other suits are pending against Körting Bros. and Buss, Sombart & Co.; decisions in these cases are expected to be rendered very soon. Schleicher, Schumm & Co., the Otto Gas Engine Works, Philadelphia, manufacture the engine in this country.

Bulkhead.—The following proposals for the construction of between 400 and 600 ft. of stone bulkhead on pile and timber foundations, in the City Dock, were opened April 12 by JAMES HODGES, Mayor, Baltimore, Md.: D. A. Gillies (care of Frederick & Pratt, Baltimore); per 100 ft. of wall for all excavating, grading, etc., $725; yellow pine piles, driven and cut off, $6.50 per pile; oak piles, driven and cut off, $9 per pile; timber, plank, etc., including fitting, $26.50 per 1,000 ft. B. M.; iron bolts, spikes, straps, etc., 6.5 cts. per pound; masonry, in place, $10.50 per cu. yd.; coping, in place, $3.75 per ft.——W. R. Weaver & Co., Baltimore; $125, $3.40, $5.40, $21.50, 3.8 cts., $5.25, $1.80.——Ross & Sanford, Baltimore; $500, $3.45, $6, $24, 3.75 cts., $7, $2.40.——Andrew Brown, Baltimore: $500, $3.75, $5.50 $22, 4 cts., $5.45, $2.75. N. H. HUTTON is Engineer of the Harbor Board.

Water-Pipe.—The following proposals for furnishing and laying water-pipe in the public grounds at Washington, were opened April 7 by Col. JOHN M. WILSON, U. S. A., Office of Public Buildings and Grounds, Washington, D. C.: John Lyon, 45 cts. per ft., $378; Wm. Rothwell, 69 cts., $579.60; Goodall & Thomas, 70 cts., $588; Alex. Tennant, 77 cts., $646.80; R. G. Campbell, 88¼ cts., $763.30; Edward Gorman, 89 cts., $747.60; Riddy & McKee, 90 cts., $756; Bernard D. Gallagher, 95 cts., $747.60. The bidders were all Washington parties and the prices were per lin. ft. complete for furnishing and laying, including the necessary fixtures and the repair of pavements; the pipes will be laid 3 ft. 6 in. deep, the trenching being done by the government. There will be 2-in. and 4-in. cast-iron pipe, ¾-in. and 1¼-in. galvanized iron pipe, bends, tees, valves, etc.

Bridge.—The following proposals for an iron bridge over the Guadalupe river were received April 5, by H. E. FISCHER, County Judge of Comal county, at New Braunfels, Tex.: King Iron Bridge & Manufacturing Co., Cleveland, O., $25,600; Kansas City Bridge Co., $27,800; Missouri Valley Bridge & Iron Works, Leavenworth, Kan., $30,863; Columbia Bridge Co., Dayton, O., $31,924; Morse Bridge Co., Youngstown, O., $36,000. The contract was awarded to the King Iron Bridge & Manufacturing Co. All the bids were for the work complete, including substructure, superstructure and approaches of trestle work and embankment, in accordance with plans and specifications on file in the office of the county judge. The bridge will have two spans of 220 ft. each, roadway 17 ft. wide between trusses, capacity 70 pounds per sq. ft. of floor; there will be 165 ft. of trestle at each side and probably 15 ft. of embankment. There will be three masonry piers, the center one about 54 ft. high and two land piers about 38 ft. high. The bridge is to be completed by October.

Submarine Pipe Laying.—Thacher & Breymann, submarine engineers, of Toledo, O., are engaged at Racine, Wis., in laying three river crossings and putting 7,000 ft. of 24-in. pipe out into Lake Michigan for the Racine Water Co.

Elevators.—The contract for four passenger, one library and two area elevators at the State, War & Navy Department Building, Washington, D. C., has been awarded to the Crane Elevator Co., of Chicago, for $17,190.

Steel Works.—The Hammond Steel Manufacturing Co. has made a proposition to establish rolling mills for the manufacture of commercial forms of steel at North Beach and Oakland, Cal.

The Richmond Railway Connection & Wharf Co., headed by Col. A. S. BUFORD, has been incorporated at Richmond, Va., with a capital stock of $3,000,000. The company will construct connecting lines, piers, docks, elevators, etc.

Boring.—The Randolph Coal, Gas & Manufacturing Co. has awarded a contract to the Diamond Prospecting Co., of Chicago, for boring for gas and coal in Randolph bottoms, near Kansas City, Mo. The hole will be sunk at least 1,200 ft.

Garbage Furnace.—The Board of Health, Pittsburg, Pa., has awarded the contract for one 30-ton garbage furnace to the Rider Garbage Furnace Co., at $3,000. No other furnaces will be built until it is seen how the first one works; six furnaces are contemplated.

Bridge Repairs.—The following proposals for the repairing and replanking of the Third street bridge nave been received by the Commissioner of City Works, Brooklyn, N. Y.: James DuBois, $2,500; Hugh Hart, $2,563; John D. Walsh, $2,597.

Iron Work.—The contract for the new iron train sheds at Indianapolis, Ind., has been awarded to J. C. Schultz, of Pittsburg, for about $1,600,000. The contract for roofing, cornices, skylights, etc., has been awarded to T. W. Irwin, of Allegheny, for $80,000.

Public Works.—The Governor of Tennessee has signed the bill to create a Board of Public Works for Chattanooga, for the purpose of improving the streets and providing the necessary sewerage, and to authorize the mayor and aldermen to issue $500,000 in bonds to enable the Board to carry out its duties, and to provide for a sinking fund.

Cross Ties.—Mr. Benham, agent for C. C. Long & Co., St. Paul, Minn., has been in Brainerd, Minn., recently, to let contracts for 200,000 ties for a southern railroad; delivery to be made in September at Sauk Rapids, thence by rail to St. Paul and by steamboat to the South. The price is 23 cts. and better for jack pine.

Embankment Protector.—Abraham M. Kanters, of Holland, Mich., has patented a protector for embankments, consisting of a layer of branches, etc., held in place by stakes driven into the bank, with wires stretched along the face of the covering, and secured to the stakes. The stakes are shod with metal shoes, of a pyramidal or conical shape, the base being wider than the width of the stake.

Pipe.—At Covington, Ky., the following bids have been received for 35,000 ft. of 30-in. cast-iron pipe: Cincinnati & Covington Pipe Co., pipe, $28.40 per ton; specials, $50. Dennis Long & Co.; Louisville, Ky., $30.97, $65. R. D. Wood & Co., Philadelphia, Pa., $30.80, $70. Gloucester Iron Works, Philadelphia, Pa., $32.91, $75. Lake Shore Pipe Co., Cleveland, O., $33.20, $75. Buffalo Pipe Co., Buffalo, N. Y., $33.70, $70.

Dike.—The following proposals for the construction of a dike in the Delaware river from the lower end of Reedy island were opened April 8 by LIEUT. COL. HENRY M. ROBERT, U. S. Engineer Office, Philadelphia, Pa.: Milo W. Locke, Kentmere, Del.; brush mattress, 4,000 cu. yds., $1.40 per cu. yd.; stone, 14,000 cu. yds., $1.45 per cu. yd.; total, $25,900. John Salterlee, Englewood, N. J., $1.53, $1.49, $26,980. Ira Lunt, New Castle, Del., $1.74 $1.50, $27,960. John A. Bouker, New York City, $1.97, $1.63, $29,500. Francis H. Smith, New York City, $2, $1, $35,000. Alex. J. Hornell and Sherman Petrie, New York City, 73 cts., $1.62½, $25,670 (informal). The contract was awarded to Milo W. Locke.

Water-Works.—Six proposals have been received for the establishment of a system of water-works at Kokomo, Ind., three of which as were follows: American Water-Works & Guarantee Co., Muncie, Ind.: eight miles of mains, 120 fire hydrants, $3,400 per annum, $30 for each additional hydrant, 15 years contract.——A. N. Grant Water-Works Co.; seven and a half miles of mains, 90 fire hydrants, $4,200 per annum, $35 for each additional hydrant, 20 years contract.——Turner, Clarke & Rawson, Boston, Mass.; eight miles of mains, $3,500 per annum, $30 for each additional hydrant, 20 years contract. The one selected by the Council, who took a vote of the people on April 8, was accepted by the following vote: 847 for water-works, 125 against, giving a majority of 722 in favor of the works. The contract will probably be awarded to the American Water-Works & Guarantee Co.

The Mason, Gooch & Hoge Co. has been incorporated at Frankfort, Ky., to build railroads, bridges, water-works, etc. Capital stock, $500,000.

Railroads, Bridges and Canals.

Iron in New York State.—The Kingston & Pembroke Iron Mining Co. has been incorporated at New York with a capital stock of $5,000 000: HENRY SEIBERT is President. The company will develop the rich iron ore district on the line of the Kingston & Pembroke R. R.; it has secured 8,000 acres of mineral land and has already three mines producing Bessemer ore.

The Effects of Railroads.—The fact that two important railroad systems will cross the international boundary at Sault Ste. Marie, Mich., has caused a great boom and a speculative mania for real estate at that place. The town will, however, become an important business center, an extensive flouring interest is expected to be established, and there is an unfailing and ample water power in the river.

Railroad Surveys.—Mexican National Ry. Surveys have been commenced on the Pacific branch which is now proposed to run from Salvatierra to Guadalajara *via* the valley of the Rio Lerma.——Spokane & Palouse R. R. Two parties are making the final location and will meet at Pullman, W. T. The engineers of the Oregon Railway & Navigation Co. are running a line from Colfax to Genesee and a preliminary from Pullman to Genesee to parallel the Spokane & Palouse road.——Savannah & Western R. R. The survey for a line from Savannah, Ga., to the E. T., V. & G. R. R. has reached the Oconee river, a distance of 90 miles.——Central Nebraska R. R. The survey has been started from Omaha, Neb., and 150 miles are to be built this season. The Chicago, Milwaukee & St. Paul R. R. Co. will equip and operate the road.——Virginia Western R. R. Two parties are locating the line from Buchanan, Va., to connect with the Tennessee Midland R. R. at the State line.——Canastota, Morrisville & Southern R. R. The surveys of this New York line will be commenced as soon as the snow disappears.——Tombigbee R. R. The location has been commenced by Major KELLY, of Columbus, Miss.——Washington & Idaho R. R. Surveys are being made by P. ZHANER, C. E., from Farmington to Spokane, W. T., and from Farmington to Mullen, in the Cœur d'Alene county.——The surveys of the Decatur & Columbus R. R. and the Decatur & Aberdeen R. R. will be started at once from Decatur, Ala., by R. S. PAYNE, C. E., of Virginia.——Northern Maine R. R. A preliminary survey will be made shortly from the Maine Central R. R. to Houlton and Presque Isle. GEO. P. WESCOTT, of Portland, is interested.

Grading and Track-laying.—The St. Louis, Fort Scott & Wichita R. R. has laid its track into Kiowa, Kan.——Tracklaying is progressing on the Silver Springs, Ocala & Gulf R. R. in Florida.——The Chicago, Kansas & Nebraska R. R. is graded across the Indian Territory into No-Man's-Land; track is laid to near Topeka, Kan., and three track laying machines are at work; there will be no stop till El Paso, Tex., is reached.——Grading for the Burlington & Missouri River R. R. new line has been commenced at Central City, Neb.——Grading has been commenced on the Orlando & Winter Park R.R. in Florida.——The Leavenworth Northern & Southern R. R. is graded in the city and track laying will soon be commenced.——The Denver, Memphis & Atlantic R. R. is being graded between Winfield, Kan., and Dexter, 20 miles.——Brockville, Westport & Sault Ste. Marie R. R. Grading has been done for 40 miles and track laying will be commenced this spring.—On the Colorado Midland R. R. 25 miles are graded from Colorado Springs and track laying is progressing a mile a day: the grade is finished to Hilton, 85 miles west of Colorado Springs.——On the Broken Bow line, in Nebraska, track laying has reached Lena, Neb.——The St. Paul, Minneapolis & Manitoba R. R. has commenced track laying on the road from Rugby Junction to Battineau, Minn., which is all graded.——Grading and track laying is progressing on the Chicago, Danville & St. Louis line from Danville, Ill., to Tuscola.——The Atlantic, Greenville & Western R. R. is being graded between Cokesbury and the Saluda river, S. C.——On the Southern Pacific R. R. track laying has been stopped near San Buenaventura, Cal., for want of rails.——The Louisville, St. Louis & Texas R. R. is being graded between West Point, Ky., and Cloversport.——On the Sheffield & Birmingham R. R., in Alabama, track is laid to the Big Cut on section 29 and will reach Bear creek this month.——Grading will soon be commenced on the Spokane & Palouse City R. R. in Washington Territory.

An Oil Storage Bill.—A bill has been introduced into the Pennsylvania Senate by Mr. GRADY, which requires that petroleum oil for street illumination must be kept in air-tight tanks of boiler iron, strong enough to resist a pressure of 50 pounds per sq. in., and provided with a vent valve to prevent explosion. The tank to stand in a fire proof building of brick, stone or iron. Parties using the oil to take out a permit for the construction of such a tank and building, and permits to be issued only to those having an actual capital or property in the State representing $10 for each barrel stored during the year.

The Quebec Bridge.—A meeting was held at Quebec, Canada, on April 1, called by the Mayor, to consider the means of organizing a company for the construction of a railroad bridge across the St. Lawrence. Resolutions were adopted to the effect (1) that the bridge would be of the utmost commercial importance, as it would form a connection on Canadian territory between the Intercolonial and the Canadian Pacific railroads and would enable the new and projected lines on the North shore to connect with the Grand Trunk, the Intercolonial, and other lines on the South shore; (2) that it should be a national work and should be assisted considerably by the Dominion government, and (3) that the capital stock of the company be $500,000, the bridge to be independent of railroad control, certain rates for crossing being charged. A. L. LIGHT, C. E., described the proposed bridge. Mayor LANGELIER is at the head of the committee to take care of the project.

Electric Railroads.—Los Angeles, Cal. The Council has passed a resolution requiring electric railroads to have the wires underground in future instead of on poles.——Pasadena, Cal. An electric railroad on the Enos suspension system, is to be built to Santa Monica, a distance of 20 miles.——Ithaca, N. Y. Electricity will be adopted for the street railroad; the Safety Electric Railway & Power Co. will furnish the plant.——Reading, Pa. The Perkiomen Avenue R. R. Co. will convert that line to an electric system.——Camden, Me. HON. J. B. STEARNS proposes to establish an electric railroad to Rockland.——Scranton, Pa. The electric railroad system is to be extended.——Lima, O. Work has been commenced on the electric railroad.

Railroad Companies.—Cheyenne & Burlington R. R. Co.; Cheyenne, Wyo.; G. W. HOLDREDGE; capital stock, $600,000.——New York, Wheeling, St. Louis & Chicago R. R.; Springfield, Ill.; to continue the Indiana line of the same name to East St. Louis; E. C. RICE, St. Louis, Mo.; capital stock, $5,990,000.——Alexandria & Texas R. R. Co.; R. W. BRINGHURST, Alexandria, La.; capital stock, $1,500,000.——Decatur, St. Louis & South Atlantic Short Line R. R. Co.; from Cairo, Ill., through Decatur, Ala., to the Georgia State line; E. C. GORDON, Decatur, Ala.——Decatur, Cincinnati & Southwestern R. R. Co.; from Decatur, Ala., to Tennessee and Kentucky; E. C. GORDON, Decatur, Ala.——Chicago Terminal & Connecting Ry. Co.; from Chicago to the Chicago & Great Southern R. R. at Blue Island; JOHN D. ADAIR, Hyde Park, Ill.; capital stock, $3,500,000.——Kansas & Colorado R. R. Co., Salina, Kan.; from Salina to Pueblo, Col.: GEORGE J. GOULD, New York; CHARLES E. FAULKNER, Salina; capital stock, $16,000,000; the line is in the Kansas Pacific interest.——Walla Walla & Puget Sound R. R. Co.; J. M. CORNWALL, Walla Walla, W. T.; capital stock, $2,000,000.——Bridgeport & South Chicago R. R. Co.; ROBERT M. ORR, Chicago; capital stock, $2,000,000.——Rockland, Rockport & Camden R. R. Co.: a Maine line about eight miles long; H. C. CLEAVES, Portland, Me.——Fort Smith, Paris & Dardanelle R. R. Co.; in Arkansas, 80 miles; J. HENRY, Fort Smith, ARK.; capital stock, $1,000,000.——Three Falls R. R. Co.; from Hutchison, Minn., to Sioux Falls, Dak.——Santa Rosa, Sebastopol & Green Valley R. R. Co.; from Santa Rosa, Cal., west to Sebastopol and northwest to the San Francisco & North Pacific R. R. near Occidental; 15 miles; GEORGE WHITTEL, San Francisco; capital stock, $300,000.——Delphos & Paulding R. R. Co.; Delphos, O.; W. H. FULLER, Chief Engineer.——Richland R. R. Co.; from Nashville, Tenn., to Hillsboro, 12 miles; J. E. CALDWELL.——Valley Falls & Tidewater R. R. Co.; Cumberland R. I.; DARIUS GOFF.——Dodge City, Montezuma & Trinidad R. R. Co.; Dodge City, Kan.; narrow gauge, from Arkansas City, Kan., to Trinidad, Col.; capital stock $2,500,000.——Rock Island, Dodge City & Denver R. R. Co.; Dodge City, Kan.; capital stock, $2,500,000.

Cable Railroads.—Denver, Col. The Denver Cable Ry. Co. has been incorporated by JOB A. COOPER, and others, with a capital stock of $500,000.——St. Louis, Mo. The Citizens' Ry. Co., JULIUS S. WALSH, President, has contracted for a cable road system, to be in operation by October; on the suburban line the cars will have a speed of from 10 to 14 miles per hour; the combined Hallidie and Root systems will be adopted.——Brooklyn, N. Y. The Nassau Cable R. R. Co., incorporated in 1884, has again applied for a franchise.——Kansas City, Mo. The Third street loop of the Grand avenue line is under construction and work is progressing on Grand avenue and the 15th street branch. Work has been commenced on the 12th street line. The Fifth street Metropolitan line will be in operation shortly. Two other lines are contemplated.——Omaha, Neb. Proposals have been received for the building of the cable engine station.——St. Joseph, Mo. James Lillis & Co., of Kansas City, cable railroad contractors, have made a proposition to build a cable system.——Roseville, N. J. A cable line is proposed from the Market street depot to East Orange; JAMES PANISTER, is interested.——Pittsburg, Pa. The Cable R. R. Co. has completed its plans and will soon commence work on the station; the conduit will not be commenced before May.——San Francisco, Cal. The Omnibus R. R. Co. has been authorized to lay cable lines.

Rapid Transit.—Lincoln, Neb. The Lincoln Rapid Transit Co. has been incorporated by J. W. MCDONALD, ALEX. CULVER, and others;——Kansas City, Mo. The Kansas City, Mastin Park & Westport R. R. Co. has been incorporated to build a belt line to accommodate Rosedale, Olathe and other towns; it will be a motor line and will have a total length of about 40 miles.——Atchison, Kan. The Council has granted the right of way for the rapid transit line and work is to be commenced at once; S. B. GLAZIER is President.——Independence, Mo. The Kansas City & Independence Dummy Air-Line has had nearly all the stock subscribed.——Lawrence, Kan. Surveys are being made for the rapid transit line.——Rome, Ga. The Forestville & Printup City Street R. R. Co. has been organized to build a motor line: capital stock, $25,000; address, J. A. STANSBURY.——Dallas, Tex. Col. W. D. WYLIE and W. M. ALEXANDER, have arranged with St. Louis parties for the construction of an elevated railroad to the highlands at a cost of about $200,000.

Railroads in Asia.—A party of French capitalists has been negotiating with the Turkish government for an extension of the railroad from the Bosphorus to Ismidt as far as Angora; their proposals were definitely rejected, but as the government recognizes the need of the railroad to prevent famine and give work to the unemployed, a concession will probably be granted to a party of English, French and German capitalists, who are negotiating for the same extension.——The Trans-Caspian Railroad has been completed from the Caspian sea to Charjui on the Oxus river; about 200 of its 650 miles are over deserts of shifting sand, which it was averred would prevent railroad construction by choking the cuttings, while the embankments would blow away; Gen. ANNENKOFF, however, covered the slopes with a layer of clay and built shrubs and plants in with the banks; some of these works have stood well for a year and a half; grass seed is to be sown and shrubs planted on the slopes of the banks. The line will be extended to Bokhara, Samarkand and Tashkend, which will open up a large cotton producing district; cotton presses will be erected along the route of the railroad. Surveys have been ordered for a line from Orenburg, on the Ural river, by the north of the Sea of Aral to Tashkend.

Bridges.—The Willamette river bridge at Portland, Ore., has been completed, the draw is 303 ft. long; steam power will not be used until June. WM. BECK is President of the Willamette Iron Bridge Co., which has a capital stock of $200,000.——At Baltimore, Md. an order has been passed authorizing the building of a bridge across Jones's Falls at Cedar avenue.——The Illinois Central R. R. Co. will soon commence work on the piers of the Ohio river bridge at Cairo, Ill.——A wooden bridge near Palatka, Fla., was burnt recently and the County Commissioners will probably build a new one.——The White Star Line Steamboat Co. has petioned for an injunction to restrain the Rome & Decatur R. R. Co. from building a bridge over the Oostanaula river, Ga., as it would entirely prevent navigation.——At Fairfield, Me., $7,500 have been raised for an iron bridge across the pond.——The New Jersey Central R. R. is putting up a new steam power draw on the Newark Bay bridge.——At Plano, Tex., an iron bridge will be built over Spring creek by Collin county; address W. D. PEABCE.——A railroad bridge is to be built at Atchison, Kan., in the interests of the Burlington & Missouri; Chicago, Rock Island & Pacific, and A., T & S. F. railroads.——The Boston & Maine R. R. Co. will build a new double track iron bridge over the Salmon Falls river at South Berwick, N. H., to replace the present wooden bridge: it will be 547 ft. long, in three spans and will cost $32,000; plans for a stone bridge with six arches of 50 ft. span, to cost $150,000, were prepared by O. S. Ross, C. E., of Kennebunk, but the iron bridge was decided upon.——At Boston, Mass., a new bridge 2,155 ft. long, with a draw, is to be built across the Charles river to Cambridge.——At Manchester, N. H., it is proposed to build a bridge across the Merrimack river at Goffe's Falls.——At Milwaukee, Wis., the Chicago & Northwestern R. R. will build a new bridge over the tracks at La Fayette place.——The Commissioners of Lancaster county, Pa., and Chester county, will erect an iron bridge, 75 ft. span, across the Octoraro creek between Atglen and Christiana.——At Southampton, L. I., a bridge will be built across the Great South bay from Podunk point to the beach.——The Pittsburg, Fort Wayne & Chicago R. R. bridge across the Beaver river between New Brighton and Beaver Falls, Pa., has been condemned as unsafe by the officials of the Pennsylvania R. R.——At St. Paul, Minn., the railroads have been ordered to build bridges over certain streets, in accordance with plans on file in the office of the City Engineer.——The Reiglesville Delaware Bridge Co., of Reiglesville, N. J., owning the wooden bridge over the Delaware, is negotiating with the Durham Iron Co. for a new iron bridge.